

BWYD A DIOD CYMRU
FOOD AND DRINK WALES



Llywodraeth Cymru
Welsh Government

www.gov.wales





Food for the *Future*

A review of food, health and nutrition policy by the ZERO2FIVE Food Industry Centre at Cardiff Metropolitan University on behalf of the Welsh Government.

REPORT

Prepared by: Dr Ellen W. Evans

Contributors: Dr Ruth Fairchild, Hilary Wickett, Bethan Rowlands, Janet Holmes, Jamie Old, Ginnie Winter, Jessica Lacey, Katie Pressdee, Leanne Ellis, Martin Sutherland, Helen Taylor and David Lloyd.

1. Executive Summary

Food, Health and Nutrition in Wales:

Obesity in Wales

More than half (58%) of adults in Wales are overweight, and more than one in five are obese.

The Welsh Health Survey 2014

The NHS in Wales spends £86 million on illnesses associated with being obese and overweight each year.

Assessing the costs to the NHS associated with alcohol and obesity in Wales Report

Food consumption in Wales

Saturated fat and sugar intakes among Welsh consumers exceed UK dietary reference values.

The National Diet and Nutrition Survey 2015

82% of men and 55% of women in Wales exceed salt consumption recommendations.

The Wales sodium survey 2007

Less than a third (32%) of adults in Wales report eating the recommended '5 a day' portions of fruit and vegetables.

The Welsh Health Survey 2014

Consumers in Wales rely heavily on convenience products to make cooking simple and quick. The major grocery categories in Wales include frozen ready-meals, canned colas, cakes/desserts and cider/spirits.

Grocery Shopping in Wales 2015

Children in Wales

Wales has the highest proportion of children in the UK with poor oral hygiene; 22% of children in Wales have severe or extensive tooth decay compared to 13% in England.

Children's Dental Health Survey 2013

Wales has the highest childhood obesity level in the UK; a quarter of children in Wales have a body mass index classified as overweight or obese compared to a fifth of children in England.

The Child Measurement Programme for Wales 2015

Diabetes in Wales

In Wales, 182,600 people have diabetes.

A further 70,000 people are estimated to be unaware they have Type 2 diabetes. Another 540,000 people in Wales are at high risk of getting Type 2 diabetes.

Diabetes UK State of the Nation: Challenges for 2015 and beyond, Wales

A rise in childhood obesity in Wales has led to an increase in Type 2 diabetes diagnosis among younger age groups.

A picture of diabetes in Wales 2015

Diabetes costs the NHS in Wales £500 million annually and it is estimated that the cost could reach £1 billion by 2025.

National Service Framework for diabetes in Wales 2013

The Welsh Government supports the food and drink sector and has devolved responsibility for the health of the people in Wales. Working with both industry and consumers, the Government, through collaboration, aims to ensure the provision of healthier food choices for consumers in Wales.

One of the goals of the [Well-being of Future Generations \(Wales\) Act 2015](#) is “a *healthier Wales*”. The aim is for a society where well-being is maximised and in which choices that benefit future health are understood.

With recent data indicating the scale of obesity in Wales and the increase in food-related health issues, it is apparent that all players in the Welsh food and drink industry have a role to play in securing “a *healthier Wales*”.

[Food for Wales, Food from Wales 2010-2020 Strategy](#) sets out a wide-ranging vision to nurture a food sector that can provide sustainable, safe, affordable and healthy food, which is of the highest standard, with positive social benefits and the lowest environmental impacts. Additionally, [Towards Sustainable Growth: An Action Plan for the Food and Drink Industry 2014-2020](#) has the development and growth of the Welsh food and drink sector as a key priority.

Food, health and nutrition is a multifaceted area that has implications across diverse policy areas including:

- farming and environment;
- manufacturing businesses;
- ingredient suppliers;
- health professionals;
- food service operators;
- retailers; and
- education.

Wales is known internationally for its innovative food and drink sector. The Food for the Future report focuses on initiatives impacting the industry, including manufacturing and trade channels.

The purpose of the report is to impress upon stakeholders, particularly those in industry, of the challenges and exciting business opportunities that exist by providing a Welsh perspective of food, nutrition and health.

Findings from research indicate that intakes of nutrients which are linked detrimentally to health such as saturated fat, salt and sugar, exceed recommendations. Action is required to address these issues and reduce the risks associated with food-related health complications among consumers in Wales.

Food, Health and Nutrition Policy Overview

Whilst it is important to support Welsh producers to develop and market healthier products, not all food and drink consumed in Wales is made in Wales. Therefore, consideration must be given to potential initiatives to educate, inform and enable people in Wales to make nutritionally beneficial choices.

Research evaluating policy and strategy from UK, European and international sources was coupled with a survey commissioned for the Food for the Future report. The survey was conducted with consumers in Wales, providing a valuable insight into perceptions regarding food, health and nutrition strategies.

Several highlights from the report include:

Regulation of marketing:

Considerable efforts have already been made in the UK by prohibiting advertisements of foods high in fat, salt and sugar from targeting children directly. Findings from this report suggest that a pre-watershed ban on such advertisements would further aid healthy eating.

64% **Nearly two-thirds of consumers in Wales believe that a pre-watershed ban of high fat, salt and sugar food product advertisements would support the general public to eat healthily.**

However, the potential impact of such marketing regulations on business and media revenue must be considered.

Product reformulation:

Voluntary product reformulation in the UK has reduced levels of target nutrients, particularly salt. Whilst research suggests the need for mandatory reformulation, there is a need to evaluate how this would impact businesses.

Many consumers expressed positive attitudes towards reformulation. Although a third of consumers in Wales indicated a willingness to pay for reformulated food and drink products, some expressed concerns regarding the potential health implications of alternatives utilised for reformulation:

“For those who will always buy ready meals and sauces in jars I think this reformulation is a good idea on the whole. People may not even realise they're buying a new healthier product so for many this could be a good solution.”

“In theory reformulation is a good idea as long as the substitutes are genuinely better and don't just swap one bad thing for another.”

Taxation:

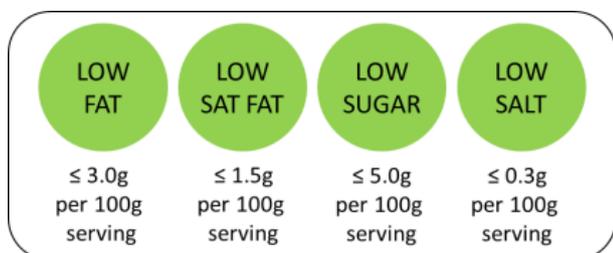
Taxation of food and drink products high in fat, salt and sugar has been reviewed in literature. This has attracted media attention (e.g. sugar tax), and data indicate that taxation of food products can have positive outcomes.

More than half of consumers in Wales believe that a tax on sugar-sweetened drinks would encourage the general population to reduce sugar consumption.

57%

Information provisions:

The majority of consumers in Wales reported they noticed and considered the front-of-pack (FOP) 'traffic light' nutritional information when shopping for food.



Over a third of consumers in Wales suggested that the use of FOP 'traffic light' nutritional information on menus when eating out would enable them to eat healthier.

Similarly, in relation to health warnings on food and drink products as documented in Finland and USA, between half and three-quarters of consumers in Wales indicated that imagery on food and drink packaging, such as health warnings, would reduce sugar consumption of the general population.



Nutritional education:

With regards to nutritional education, multiple methods were reviewed from international research including family-based education, mass media campaigns and individual targeted interventions.

Many respondents to the Food for the Future survey had suggestions for food-related health education including cooking skills, portion-size awareness and food procurement awareness, along with continued support interventions:

“To be a healthier nation we need to be taught and encouraged more to eat a balanced diet and exercise more. I know exactly what I should and should not eat but I just cannot stick to a diet - more time and money should be invested in helping people 'stick' to things.”

Access to healthier food:

Given literature suggests that deprived areas of Wales consume an unbalanced diet. Easier access (with regards to location and finance) to 'healthier' food products compared to the availability of 'unhealthy' foods was discussed by many consumers in the survey. Free fruit and vegetables and cheaper healthy food were also areas of discussion:

“Pop up stands/shows of free fresh fruit and veg in public places/events.”

“Healthy food should be cheaper than fat, convenience foods.”

“Give me money to buy healthier food.”

“Greater access to healthy options. Cheaper prices for healthy food.”

Food and Drink Sector Contribution to the Food, Health and Nutrition Agenda in Wales

The food and drink sector in Wales has a considerable part to play in health and nutrition. Exploration of how best to provide support and work with businesses and services to produce and sell food and drink that are of greater nutritional benefit to consumers has been considered.

In-depth interviews were conducted with food and drink manufacturers and processors in Wales along with industry consultants, who shared their experiences of product reformulation providing valuable insight to the process and the impacts.

Some highlights from the report include:

Voluntary reformulation drivers:

Consumer demand for 'healthier' food products and pressure by retailers to meet Responsibility Deal pledges were drivers for product reformulation among food businesses in Wales:

“The main driver for reformulation was attributed to retailer pressure.”

“The drivers behind reformulation are our customers who are acting on market trends and consumer buying behaviours.”

“Reformulation is typically customer driven; some reformulation activity is driven from within the business in an attempt to reduce manufacturing costs.”

It was determined that reformulation of food products needs to be beneficial and acceptable to the consumer whilst also being commercially viable for businesses:

“Balance needs to meet customer expectations and ensuring business efficiency.”

Barriers to reformulation:

The costs associated with reformulation were identified as potential barriers and challenges to businesses. Such costs may be financially challenging for micro businesses and SMEs in Wales. Factors including timescale, changes in sensory attributes and consumer perceptions were also discussed as potential barriers:

“The company have chosen not to undertake further reformulation, as work on the products would be very costly, further reformulation activity is limited by legislative requirements, brand standards and cost.”

“One of the challenges of reformulating recipes, especially, is to maintain the flavour of the product, as well as being mindful of food safety parameters such as pH levels which contribute to the product safety.”

“Although the business can see the benefits of reformulation, the cost in terms of technical expertise and time associated with development is noted to be the biggest barrier to reformulation.”

Benefits of reformulation:

The identified benefits of reformulation in some cases included reduced costs through reduced wastage, increased yield and increased product stability:

“Some cost savings were found during the development of these products where lower priced raw materials were used as the fat replacers yet the overall finished product price was not changed.”

“During the reformulation, less separation of the fats in emulsion and variation in flavour was observed making the product more aesthetically acceptable especially important when the product is nearing end of life.”

“One of the advantages is that in some recipes yields have increased as a result of reformulation”

Reformulation support:

To enable product reformulation potential support mechanisms were identified as part of the case studies presented in this report. These included the provision of relevant and accessible information and access to funding:

“What would make reformulation easier for the business, and in general, a wider availability or knowledge of information on application rates for ‘alternative ingredients’.”

“Small businesses are ill equipped and resourced to facilitate effective new product development so require access to an independent, qualified, technical resource to support this activity.”

“Funding opportunities to support the development process and its cost may encourage smaller businesses to invest in reformulation.”

Conclusions and Recommendations

This is a challenging period for food policy in this area with the UK Government’s Childhood Obesity Strategy due for publication and the voluntary Responsibility Deal no longer a priority.

Whilst food plays a pivotal role in health, there is a need to combine the findings of this report, which focuses on the potential initiatives to support the Welsh food and drink industry with the findings and proposals from other stakeholders involved in creating *“a healthier Wales”*.

The cumulative responsibility and role of the consumer, the food and drink sector, society and the Welsh Government must be recognised as having the potential to have a positive impact on health and nutrition. Consequently, as a result of the findings in this report, the Welsh Government should consider the development of a Nutrition Strategy for Wales.

The outcomes of this report will be utilised to further support the Welsh Government to develop a fit-for-purpose policy proposition in relation to food, health and nutrition in Wales.

The recommendations to consider

Product reformulation

Recommendation 1:

Provide accessible and affordable support for companies who are reformulating products to make them healthier.

Recommendation 2:

Develop specific initiatives to increase the number and competitiveness of healthier products in selected categories.

Consumer research

Recommendation 3:

Commission consumer research to enable Welsh businesses to better understand Welsh and UK consumers' perceptions of healthier products and messaging.

Recommendation 4:

Consider the feasibility of developing a research programme to obtain an understanding of the in-store factors that influence consumer behaviours (e.g. packaging design, merchandising, location in-store, pricing, promotional space) to inform strategies to increase sales of healthier food choices.

Research and development

Recommendation 5:

Support the uptake of research in extending shelf-life technology. Provide access to expertise to off-set the reduction in shelf-life due to fat, salt or sugar reduction.

Recommendation 6:

Explore the potential of establishing a world-leading healthier product reformulation capability in Wales.

Recommendation 7:

Explore the potential to strengthen the links between cutting-edge research (e.g. nutrition, biochemistry and food technology) and industry to enable Welsh businesses to commercialise and be first to market with innovative healthier products.

Trade channel engagement

Recommendation 8:

Engage with trade channels (e.g. supermarkets, food-service and public procurement) to understand their priorities in relation to their customers maintaining healthier lifestyles. Explore the opportunity to develop joint initiatives for Wales.

Recommendation 9:

Consider the potential for partnership with business to increase fresh and/or frozen fruit and vegetable sales in convenience stores in catchments without easy access to supermarkets or independent retailers.

Trade development

Recommendation 10:

Consider trade development activity to encourage companies supplying healthier products by supporting Welsh companies' presence at healthier food-focussed trade shows/events (e.g. Food Matters Live).

Recommendation 11:

Consider export opportunities for healthier food products to countries with a fast growing market for healthier products.

Industry analysis

Recommendation 12:

Consider conducting research with Welsh companies to obtain an in-depth understanding of the barriers to reformulating and producing healthier products.

Recommendation 13:

Consider reviewing the use of FOP nutritional labelling by Welsh companies and assess the format in-line with recommendations. Consider supporting companies to meet recommendations.

Recommendation 14:

Consider the use of the Annual Industry Survey of Welsh Food and Drink Businesses to capture more data and insights into the development of healthier products by Welsh companies.

Table of contents

1.	Executive Summary	3
2.	Introduction to the Food for the <i>Future</i> Report.....	14
3.	Element One: An analysis of existing policy and strategy in the area of health, nutrition and food	18
3.1	The role of fat in nutrition	18
3.1.1	Impact of fat on health	18
3.1.2	Guidelines on fat consumption	19
3.1.3	Consumer fat consumption data.....	20
3.1.4	Fat reduction recommendations and initiatives.....	21
3.2	The role of salt in nutrition	21
3.2.1	Impact of salt on health	22
3.2.2	Guidelines on salt consumption.....	22
3.2.3	Consumer salt consumption data	23
3.2.4	Salt reduction recommendations and initiatives.....	23
3.3	The role of sugar in nutrition.....	24
3.3.1	Impact of sugar on health	25
3.3.2	Guidelines on sugar consumption	25
3.3.3	Consumer sugar consumption data.....	26
3.3.4	Sugar reduction recommendations and initiatives	27
3.4	Food, Health and Nutrition Policy, Strategy and Consumer Education Intervention Initiatives	27
3.4.1	Regulation of marketing.....	30
3.4.2	Product reformulation	31
3.4.3	Taxation.....	33
3.4.4	Information provision	35
3.4.5	Nutritional ducation.....	38
3.4.6	Access to healthier food	41
3.5	Food, health and nutrition intervention development.....	42
4.	Element Two: Fat, salt and sugar, does industry have a part to play?	46
4.1	The role of fat in food production	46
4.1.1	Fat reduction and replacement products	47
4.1.2	Industry fat reduction efforts	48
4.2	The role of salt in food production	50
4.2.1	Salt reduction and replacement products	51
4.2.2	Industry salt reduction efforts.....	54
4.3	The role of sugar in food production.....	58
4.3.1	Sugar reduction and replacement products.....	59
4.3.2	Industry sugar reduction efforts	60
4.4	Reformulation	63
4.4.1	Drivers for reformulation	63
4.4.2	Barriers to reformulation	64

4.4.3	Benefits of reformulation.....	66
4.4.4	Support to enable reformulation	67
4.5	Responsibility Deal	67
5.	Discussion	69
6.	Recommendations arising from the Food for the <i>Future</i> report	71
6.1	Product reformulation	71
6.2	Consumer research	72
6.3	Research and development	73
6.4	Trade channel engagement	74
6.5	Trade development.....	74
6.6	Industry analysis	75
7.	References	76
8.	Appendix: Research Commissioned for this Report	93

List of tables

Table 1: Overweight and obesity rates in the UK and Ireland*	14
Table 2: UK population average recommendations for percentage of daily food energy from fat	20
Table 3: Population dietary salt targets set worldwide adapted from Cappuccio <i>et al.</i> (2011)	22
Table 4: UK salt recommendations and salt intake per day	23
Table 5: Comparison of recommended maximum intake and consumption of sugar (adapted from PHE (2015b) and sugar intake measured as NMES from PHE (2014a))	26
Table 6: Sources of 'Free sugars' as percentage of daily intake (PHE, 2014a)	26
Table 7: The "4Ps" marketing approach applied to public health nutrition policies (Lloyd-Williams <i>et al.</i> , 2014)	29

List of figures

Figure 1: Consumer responses regarding reformulated food products	32
Figure 2: The ‘Thai Food, Good Heart’ and the ‘Less Salt is Healthier’ logos to indicate a reduced salt content (Centre for Science in the Public Interest, 2015).	33
Figure 3: Consumer responses regarding taxation of food products high in fat, salt and sugar	34
Figure 4: Imagery on sugary-drinks to aid consumers to consume less sugar.....	38
Figure 5: Consumer responses regarding nutritional education	41
Figure 6: Consumer responses regarding availability of healthier foods.	42
Figure 7: Claire Talbot – Independent Product Innovation Specialist, fat reduction in crème fraiche.....	49
Figure 8: Claire Talbot – Independent Product Innovation Specialist, fat reduction in deep fried coating system for fish.....	50
Figure 9: Salt reduction case study from Lewis Pie & Pasty Company, a Welsh bakery producing a wide range of pies and pastries.	54
Figure 10: Salt reduction case study from a Welsh ready meal manufacturer with over 100 products supplying catering, retail and foodservice markets. ...	55
Figure 11: Salt reduction case study from Claire Talbot, Independent Product Innovation Specialist on salt reduction in seasoning for meat products ..	56
Figure 12: Salt reduction case study from Claire Talbot, Independent Product Innovation Specialist on salt reduction in dairy based sauces.....	56
Figure 13: Salt reduction case study from Charcutier Ltd.....	57
Figure 14: Sugar reduction case study from Fruitapeel Ltd.....	62
Figure 15: Sugar reduction case study from Liz Tucker, Registered Nutritionist/Food Industry Consultant at Selectfood.....	62
Figure 16: Reformulation case study by Baraka Foods Ltd.....	64
Figure 17: Reformulation case study from Liz Tucker, Registered Nutritionist/Food Industry Consultant at Selectfood.....	65

List of acronyms and abbreviations

BDA	–	British Dietetic Association
BDA	–	British Dental Association
BMPA	–	British Meat Processors Association
BSDA	–	British Soft Drinks Association
CHD	–	Coronary Heart Disease
CVD	–	Cardiovascular Disease
DoH	–	UK Government Department of Health
DRV	–	Dietary Reference Value
FSA	–	Food Standards Agency
HDL	–	High-density lipoprotein
LDL	–	Low-density lipoprotein
NDNS	–	National Diet and Nutrition Survey
NMES	–	Non-Milk Extrinsic Sugars
NPD	–	New Product Development
NSP	–	Non-starch polysaccharide
PHE	–	Public Health England
SACN	–	The Scientific Advisory Committee on Nutrition
SMEs	–	Small and Medium Enterprises

2. Introduction to the Food for the *Future* Report

Over recent years, numerous sources have suggested that many people in the UK are overweight and obese (see Table 1). Recent data from the Welsh Health Survey indicate that more than half (58%) of adults in Wales are overweight, and more than one in five are obese (Welsh Government, 2015b). Although this indicates that Wales has the lowest proportions of overweight and obesity rates in the UK and Ireland, there remains a cause for concern given the health implications of overweight and obesity and the resulting costs.

Table 1: Overweight and obesity rates in the UK and Ireland*

Country	Overweight & Obese	Obese	Data date	Reference
Wales	58%	22%	2014	Welsh Government (2015b)
England	67% men 57% women	26% men 24% women	2013	Health and Social Care Information Centre (2014)
Scotland	65%	26%	2014	The Scottish Government (2014)
Northern Ireland	59%	25% men 23% women	2005/ 2006	Irish Medical Organisation and British Medical Association Northern Ireland (2010)
Republic of Ireland	64% men 53% women	26% men 24% women	2007	Irish Medical Organisation and British Medical Association Northern Ireland (2010)
*Given the differences in time of data collection and methods utilised, these data are not statistically comparable				

The economic and health costs of overweight and obesity in the UK have been calculated and it is estimated to cost the NHS £3.2 billion annually (Allender & Rayner, 2007). Although obesity is described as a chronic illness, it is a chronic illness that can be prevented. It is suggested that there needs to be clear distinctions between obesity treatment and obesity prevention (Kumanyika & Obarzanek, 2003).

The World Health Organization (WHO) have identified the fundamental cause of obesity and overweight to be an energy imbalance between calories consumed and calories expended, as a result of increased consumption of high-fat, energy-dense foods and a reduction in physical activity (changes in work, transportation and urbanisation) (WHO, 2015b). The WHO sets out the possible clinical and public health consequences associated with overweight and obesity (WHO, 2015b), which are major risk factors for a number of chronic diseases, including diabetes (Sullivan *et al.*, 2008), cardiovascular diseases (Hubert *et al.*, 1983) and cancer (Calle & Kaaks, 2004; Calle & Thun, 2004).

Researchers have calculated the healthy life-years and total years of life lost resulting from the effect of excess bodyweight on cardiovascular disease and diabetes (Grover *et al.*, 2015), indeed, obesity is an avoidable risk factor for such life-threatening diseases and for serious morbidity (Garrow, 1992).

In Wales, diabetes has been described as an epidemic (Diabetes UK, 2015; National Assembly for Wales, 2013). A report on the state of diabetes in Wales in 2015 indicates that the number of people with diabetes increases dramatically year-on-year. In addition to the 182,600 people in Wales that have diabetes, it is estimated that an additional 70,000 people are unaware that they have Type 2 diabetes. In addition, another 540,000 people that are classed as having a high risk of developing Type 2 diabetes (Diabetes UK, 2015).

Furthermore, concerns regarding childhood obesity in areas of Wales have recently been raised in the Child Measurement Programme for Wales (CMPW). A quarter of children in Wales have a body mass index classified as overweight or obese compared to a fifth of children in England (Public Health Wales NHS Trust, 2015). Although the CMPW determined that no significant difference occurs in obesity prevalence between children living in rural or urban areas (just one child in 12 living in Glamorgan were obese compared to one-in-six in Merthyr Tydfil), nearly a third of children on Anglesey are overweight or obese (Public Health Wales NHS Trust, 2015). Childhood obesity can have short-term and long-term health consequences (Reilly *et al.*, 2003) and it is reported that the rise in childhood obesity has led to an increase in cases of Type 2 diabetes diagnosis among younger age groups in Wales (Watkins & Jones, 2015).

Healthy eating behaviours are lacking among people in Wales. Kantar data indicate that many consumers in Wales rely heavily on convenience products to make cooking simple and quick. Furthermore, in comparison with Great Britain (GB), consumers in Wales pay less for groceries by purchasing foods in cheaper outlets and shop less often. Discount/bargain stores and freezer centres have stronger performance in Wales than in GB. Data indicate that the major grocery categories in Wales include frozen ready-meals, canned colas, cakes/desserts and cider/spirits. Although consumers in Wales do purchase vegetables (including potatoes and leeks), consumption of exotic fruits and salads are less than GB (Kantar Worldpanel, 2015).

The '5 a day' campaign is based on WHO advice, which recommends eating a minimum of 400g of fruit and vegetables a day to lower the risk of serious health problems, such as heart disease, stroke, type 2 diabetes and obesity (NHS, 2015). However, less than a third (32%) of adults in Wales report consuming the recommended five or more portions of fruit and vegetables a day (Welsh Government, 2015b). Women (aged 19 to 64 years) and older adults (aged 65 years and over) in Wales consumed significantly fewer portions of fruit and vegetables than the same age groups in the UK as a whole (Food Standards Agency in Wales *et al.*, 2015). As part of the British Heart Foundation's Food4Thought Campaign, it was determined that the majority (88%) of 11 – 16 year olds were not eating the recommended five portions of fruit and vegetables each day. In fact, it was reported that children were more likely to consume crisps (34%) rather than fruit (31%) at lunch time (Physical Activity and Nutrition Networks Wales, 2015). Data from the Family Food report indicate that consumption of fruit and vegetables is lowest in low income households (DEFRA, 2015). Indeed, those living in the most deprived areas of Wales have the lowest consumption of fruit and vegetables (Food Standards Agency in Wales *et al.*, 2015).

Consequently, such data indicate the critical importance of one of the seven goals of the Well-being of Future Generations (Wales) Act 2015 (National Assembly for Wales, 2015), which is 'A healthier Wales'. The aim is for a society in which well-being is maximised and in which choices that benefit future health are understood.

Many elements can be addressed to aid consumers to reduce the risk of being overweight and obese but this is a complex challenge that requires an integrated approach. Individually, people can limit energy intake from total fats and free sugars, increase consumption of fruit, vegetables, wholegrains and nuts, and engage in regular physical activity. The food industry can promote healthy diets by reducing the fat, sugar and salt content of processed foods through reformulation, ensuring that affordable nutritionally healthy food options are available for consumers; ensuring responsible marketing of food products aimed at children and teenagers; and ensuring the availability of healthy food choices in the workplace (WHO, 2015b).

The relationship between nutrition and health has long been established. Nutrition is an adaptable and influential factor in the promotion of health, prevention of disease, treating ill-health and for the improvement of the quality of life (Gibney *et al.*, 2013). The varied rural diet of past times, has been replaced by an industrial diet rich in fat,

salt and sugar, indeed, the ‘nutrition transition’, in which the term ‘malnutrition’ has been broadened to include people that do not get the right balance of food as a result of reliance on highly processed convenience foods that save time and money (Murcott *et al.*, 2013). It can be seen that there is an essential need to improve the food-related health and nutritional status of people in Wales.

This is a multifaceted area that has implications across diverse policies. In addition, there are a number of key areas impacted by food and health related policies, including:

- farming industry;
- manufacturing businesses;
- ingredient suppliers;
- health professionals;
- food service operators;
- environment;
- retailers; and
- the education sector.

For the purpose of this report, two key policy areas that will be addressed are:

- aiding individuals and communities to make healthier choices and health-improving behaviours through food choices; and
- encouraging and working with food businesses and services to produce and sell food that is of greater nutritional benefit to consumers.

There are three nutrients that are a central focus to this report:

- fat;
- salt; and
- sugar.

This report will consider existing policy and strategy in the area of health, nutrition and food and consider the role of the food industry in developing healthier food products.

3. Element One: An analysis of existing policy and strategy in the area of health, nutrition and food

3.1 The role of fat in nutrition

Small amounts of fats are essential to health, for example by forming a key part of cell membranes (Webb, 2012). The main types of fat include saturated (harder fats, including lard, butter, fat on meat), unsaturated fats (liquid fats and oils from plant foods, including polyunsaturated sunflower, corn and sesame oils, and monounsaturated olive and rapeseed oils) and Trans-fats (hydrogenated vegetable oils that are processed to make harder) (BDA, 2015a).

3.1.1 Impact of fat on health

All types of fat provide the same number of calories (9kcal/g) and contains more calories than protein and carbohydrates (4kcal/g) (BDA, 2015a), regardless of where they come from. Too much of any type of fat can encourage weight gain (British Nutrition Foundation, 2013) and the digestible energy content of all dietary fat is 95%. High-fat foods, which contain a considerable amount of energy, are described as energy-dense foods and over consumption of such foods can lead to an excess energy intake (British Nutrition Foundation, 2013). Balancing the consumed energy with utilised energy is essential to avoid becoming overweight and obese (Food Agriculture Organization of the United Nations, 1998) with excess energy being stored as body fat (British Nutrition Foundation, 2013). It is suggested that the increase in the proportion of fat in the British diet is believed to be a significant contribution to overweight/obesity (Prentice & Jebb, 1995).

A systematic review by Hooper *et al.*, (2012) of 33 randomised control trials and 10 cohort studies found that diets lower in total fat were associated with lower relative body weight. Lower total fat intake leads to small but statistically significant and clinically meaningful sustained reductions in body weight in adults. In studies with fat intakes of less than 30% of energy intake (Hooper *et al.*, 2012) compared to the recommended 35% of energy intake from total fat (Great Britain Panel on DRVs & DoH, 1991) lower relative body weight is observed.

A wealth of epidemiologic studies have evaluated associations between dietary exposures and coronary heart disease (CHD) (Mente *et al.*, 2009). Trans-fats have not been found to increase CHD events and deaths, whilst total polyunsaturated fats and omega-3s are found to decrease them (Skeaff & Miller, 2009). A considerable volume of data indicate that replacing saturated fat in the diet with mono-unsaturated fat or poly-unsaturated fat reduce the risks associated with CVD, CHD and coronary related deaths (Hooper *et al.*, 2012; Hooper *et al.*, 2015; Jakobsen *et al.*, 2009; Mozaffarian *et al.*, 2006).

A systematic review by Skeaff and Miller (2009), found no clear relationship between intakes of total fat, saturated fat, monounsaturated fat and CHD events. It has also been determined that no reduction in cardiovascular events are observed when calories from saturated fat are replaced with those from protein or carbohydrate sources (Hooper *et al.*, 2015).

Increased consumption of trans-fatty acids is associated with an increased risk of CHD. A total energy intake of 2.1% from trans-fatty acids, compared to 0.9%, results in a 30% increased risk of CVD (Mozaffarian *et al.*, 2006). Research has determined that an intake of 5g of trans-fat daily was associated with a 23% increase in ischaemic heart disease (Mozaffarian *et al.*, 2006). Given the adverse effects of trans-fatty acids on blood lipoprotein profiles and the risk of CHD (Uauy *et al.*, 2009), there is a need to significantly reduce or virtually eliminate industrially produced trans-fatty acids from the food supply chain. This was achieved in many countries by replacing partially hydrogenated vegetable oils with healthy *cis*-unsaturated fatty acids (Uauy *et al.*, 2009).

3.1.2 Guidelines on fat consumption

The UK Government Department of Health (DoH) Dietary Reference Values (DRV) suggest that no more than 35% of daily food energy should come from fat as illustrated in Table 2 (Great Britain Panel on DRVs & DoH, 1991). However, it is suggested that the UK population's estimated intake exceeds such recommendations (DEFRA, 2014).

The WHO global strategy on diet, physical activity and health reports there is a need to limit energy intake from total fats and shift fat consumption away from saturated fats and trans-fatty acids to unsaturated fats (WHO, 2004).

Table 2: UK population average recommendations for percentage of daily food energy from fat

	Recommended % of food energy for general population	Estimated intake
Total fat	Less than 35% (Great Britain Panel on DRVs & DoH, 1991)	38.5% of food energy (DEFRA, 2014)
Saturated fat	Less than 10% (WHO, 2010)	14.3% of food energy (DEFRA, 2014)
Poly-unsaturated fat	6.5% (Great Britain Panel on DRVs & DoH, 1991)	6.8% of food energy (DEFRA, 2014)
Mono-unsaturated fat	13% (Great Britain Panel on DRVs & DoH, 1991)	15.1% of food energy (DEFRA, 2014)
Trans-fats	Less than 2% (Great Britain Panel on DRVs & DoH, 1991)	0.7% of food energy (PHE, 2014a)

The Scientific Advisory Committee on Nutrition (SACN) Fats Working Group, are currently reviewing the current UK DRV for saturated fatty acid, (poly-unsaturated fatty acid and mono-unsaturated fatty acid) intakes and will make dietary recommendations in due course (SACN, 2015b).

3.1.3 Consumer fat consumption data

The Public Health England (PHE) National Diet and Nutrition Survey (NDNS) indicates that the intake of trans-fats by all age groups in the UK meet with recommendations of 2%. However, for all consumer age groups in the UK, the average saturated fat intake exceeds the recommended level of no more than 11% of food energy (PHE, 2014a).

Although mean intake of total fat met the DRV in all age/sex groups in Wales (other than men aged 65 years and over), the mean intake of saturated fatty acids was determined to exceed the DRV (no more than 11% food energy) in all age/sex groups. Mean intake of trans fatty acids was reported to meet the DRV (no more than 2% food energy) in all age/sex groups. The NDNS suggested that 'Milk and milk products', 'cereals and cereal products' and 'meat and meat products' were the main contributors to intake of total fat, saturated and trans fatty acids among consumers in Wales with 'milk and milk products' making a greater contribution for younger children (Food Standards Agency in Wales *et al.*, 2015).

The Living Costs and Food Survey established that the greatest contributory sources of total fats were from fats and oils (18.6g per person per day), non-carcass meat and meat products (12.9g per person per day) and milk and cream (7.0g per person per day). These sources, in addition to cheese, were the largest contributors of saturated fat in the diet (DEFRA, 2014). The survey also indicates that the amount of milk and

cream, non-carcase meat and meat products and fats and oils were greater in Wales compared to England. Differences were determined according to location, with people in rural areas of Wales consuming increased levels of fat (93g total fat, 35g saturated fat per person, per day) in comparison to people living in urban areas of Wales (90g total fat, 33.7g saturated fat per person, per day). Saturated fat intakes were reported to be highest in the oldest age groups and in white British ethnic groups (DEFRA, 2014). This may indicate the need for future nutritional education interventions to target the older age groups.

3.1.4 Fat reduction recommendations and initiatives

The BDA (2015a) indicate that consumers should try replacing saturated and trans fats with unsaturated fats and oils, and omega-3 fats. WHO (2015a) suggest that consumer fat intake can be reduced by:

- changing cooking methods – remove the fatty part of meat; use vegetable oil (not animal oil); and boil, steam or bake rather than fry;
- avoiding processed foods containing trans fats; and
- limiting the consumption of foods containing high amounts of saturated fats (e.g. cheese, ice cream, fatty meat).

3.2 The role of salt in nutrition

Sodium is an essential nutrient necessary for maintenance of plasma volume, acid-base balance, transmission of nerve impulses and normal cell function (WHO, 2014b). Early dietary experience appears to increase the preference for salty taste responses of infants and young children which can develop a liking for salt into adulthood (Stein *et al.*, 2012)

At present, around 75% of the salt eaten in the UK is provided via manufactured food products (He *et al.*, 2014), with approximately 10-15% from discretionary addition during consumers' food preparation and at the table (Schönfeldt *et al.*, 2013). As discussed by Sanchez-Castillo *et al.* (1987), salt exists naturally in all plant and animal products as sodium and chloride, so it is impossible to remove all 'salt' from the diet. Naturally occurring sodium and chloride in foods accounts for approximately 10% of a consumers 'salt' intake (Sanchez-Castillo *et al.*, 1987).

3.2.1 Impact of salt on health

Dahl (1972) was the first to conclusively demonstrate the ability of salt to increase blood pressure when consumed in excess to metabolic requirements. Several studies have demonstrated the link between a high salt diet and an increased risk of hypertension, CHD and stroke (Ikehara *et al.*, 2012; Shils & Shike, 2006; Villela *et al.*, 2014).

The British Heart Foundation (BHF) report that CHD is the leading cause of premature death in the UK (BHF, 2015). The BHF has also indicated that £431.3 million was spent on treating CVD in Wales during 2013-2014, of which £116.3 million was spent on treating CHD. The costs, per head of population, ranged between £106 (Cardiff & Vale UHB) and £179 (Powys Teaching LHB) (BHF, 2015).

3.2.2 Guidelines on salt consumption

The salt intake targets within most countries are set by government but some are set by non-governmental organisations. The World Health Organisation recommends that adults consume less than 5g of salt per day (WHO, 2014b). In the UK, national dietary guidelines on salt are provided by the UK DoH, advised by the SACN. US consumers are guided by salt guidelines, which are set by the Centers for Disease Control and Prevention. Canadian consumers are advised by Health Canada. As illustrated in Table 3, international salt intake targets range from 5 to 8g per person per day.

Table 3: Population dietary salt targets set worldwide adapted from Cappuccio *et al.* (2011)

Countries	Targets for salt intake
United Kingdom ¹	6g per person per day (3g by 2025)
Americas ³ , Bulgaria ¹ , Brazil ¹ , Chile ¹ , Cyprus ¹ , Czech Republic ¹ , Denmark ¹ , Fiji ¹ , Greece ¹ , Hungary ¹ , Latvia ¹ , Lithuania ¹ , Norway ¹ , Romania ¹ , Singapore ¹ , Slovenia ¹ , Spain ¹ and Uruguay ¹ .	5g per person per day
Canada ¹	5.75g per person per day
USA ¹	5.8g per person per day
Estonia ¹	6g per day for men 5g per day for women
Argentina ¹ , Australia ² , Austria, Barbados ¹ , Belgium ¹ , China ² , Germany, Indonesia ¹ , Ireland ¹ , Italy ⁵ , Japan ² , Netherlands, New Zealand ² , Poland ¹ and Portugal ¹ .	6g per person per day
Finland ¹ , Iceland ⁴ and Sweden ⁴	7g per day for men 6g per day for women
France ¹ and Switzerland ¹	8g per person per day

¹ Government
² Non-governmental organisations
³ Pan American Health Organization/World Health Organization
⁴ Nordic Nutrition

3.2.3 Consumer salt consumption data

Salt intakes in the UK have been measured since the 1940s via the National Food Survey/ Expenditure on Food Survey/Living Costs Survey (National Food Survey, 1940-2000) and more recently the NDNS (DoH & FSA, 2011).

Table 4: UK salt recommendations and salt intake per day

NDNS age group	Recommended maximum salt intake (g per day)	Salt intake (estimated g per day)*
4-6 years	3	3.7 genders combined
7-10 years	5	5.5 males, 4.6 females
11-18 years	6	7.1 males, 6.2 females
19-64 years	6	9.3 males, 6.8 females
65+ years	6	8.3 males, 6.4 females
*Figures from 2014 NDNS report apart from 19-64 years old (Sadler <i>et al.</i> , 2011).		

Findings from the most recent NDNS regarding salt consumption in Wales are yet to be published (Food Standards Agency in Wales *et al.*, 2015). The 2007 NDNS Wales sodium survey showed 82% of men and 55% of women exceeded the 6g per day salt target. The estimated daily salt intake was 9.4g for men and 6.8 g for women; or 8.1 g/day for the whole sample (National Centre for Social Research, 2007).

In the UK it is suggested that up to 70% of dietary sodium comes from manufactured food products (SACN, 2003). 'Cereals and cereal products' are reported to be the largest contributor of sodium to the diet providing 31-37% (of which 15-19% comes from bread), followed by 'meat and meat products', providing 26-29% of sodium intake from food. 'Milk and milk products' contributed 7-11% of sodium intake in the diet (Food Standards Agency in Wales *et al.*, 2015). However, it must be acknowledged that such data may underestimate total sodium intake from the diet as discretionary salt added in cooking or at the table by survey participants is not included (Food Standards Agency in Wales *et al.*, 2015).

3.2.4 Salt reduction recommendations and initiatives

The WHO (2014b) and the World Action on Salt and Health (WASH, 2015) outline a variety of measures, which should be adopted to reduce salt consumption. These include, governmental policies to encourage multi-national food companies to reformulate and reduce salt content in food products and increase availability of low-

salt products, educate and increase consumer awareness, local policy interventions and monitor consumer cognition and behaviour in relation to consumption.

Recommendations for consumers to reduce salt consumption by the WHO include, not adding salt during food preparation or when eating, limiting salty foods or selecting low-salt alternatives. Local recommendations include the removal of salt shakers from restaurants, providing targeted dietary advice and educate children to adopt low-salt diets from an early age. Actions for the food industry include incremental reductions to allow consumer tastes to adapt and increase consumer awareness (WHO, 2014b).

Reviews of salt reduction initiatives around the world report that the majority of salt reduction activity has occurred in Europe. The majority of strategies were government led. The reviews indicate that salt reduction activities covered the major areas of working with the food industry to reduce salt content in foods through reformulation, front-of-pack labelling schemes and consumer awareness or behaviour change programs. It is suggested that implementing a national salt reduction programme was a simple and cost-effective method of improving public health (Trieu *et al.*, 2015; Webster *et al.*, 2011). The UK salt reduction programme has successfully reduced the population's salt intake by gradual reformulation on a voluntary basis (He *et al.*, 2014).

As part of the Appetite for Life Action Plan, food standards for school lunches in Wales recommend that salt is not to be added to recipes or during cooking and should be replaced with herbs and spices. Salt should not be available at lunch tables or at the service counter (Welsh Assembly Government, 2008).

3.3 The role of sugar in nutrition

Sugar is a water soluble carbohydrate. Carbohydrates are a major source of energy in the diet. Sugars are a classification of carbohydrates and the term 'sugars' conventionally describes two of the smaller carbohydrates, namely monosaccharides and disaccharides. Within these sub-groups, components include glucose (monosaccharide in fruits and plant juices), fructose (monosaccharide found with glucose in ripening fruit and honey), galactose (monosaccharide occurs in milk in chemical combination with glucose as lactose), sucrose (the predominant disaccharide occurring in the free form), lactose (disaccharide in milk) and maltose (disaccharide derived from starch hydrolysis) (FAO & WHO, 1998; SACN, 2015a).

3.3.1 Impact of sugar on health

Although excessive caloric intake and physical inactivity are likely important factors driving the obesity epidemic (Johnson *et al.*, 2007), excessive consumption of sugars has been linked with several metabolic abnormalities and adverse health conditions (Johnson *et al.*, 2009). Excessive fructose intake has a critical role in cardio-renal disease (Johnson *et al.*, 2007).

Only a third of children in Wales are said to have good oral health and Wales has the highest proportion (22%) of children in the UK with severe or extensive decay (England 13%) (Health and Social Care Information Centre, 2013). Data from the British Dental Association (BDA) suggest that over 10% of children in Wales will have a tooth extracted as a result of tooth decay. Furthermore, it is suggested that there may be an unreported epidemic of tooth erosion among children in the UK, with up to 60% of children indicating evidence of tooth erosion (BDA, 2015b).

3.3.2 Guidelines on sugar consumption

SACN has recently recommended that in the UK, the maximum intake of free sugars should not exceed 5% of total dietary energy (PHE, 2015c). This has halved from previous recommendations of 10% (PHE, 2015b). This is as a result of recommendations by the WHO resulting from a meta-analysis that established an association between a reduction in the consumption of free sugars and reduction in body weight (WHO, 2015c). It is suggested that if SACN sugar recommendations were to be met within five years, reductions in excess body weight and health conditions associated with higher intakes of sugar including dental caries and comorbidities of obesity, a total NHS cost saving of £576m would be made annually (PHE, 2015b).

'Free sugars' is a new term used by PHE and WHO. It describes all monosaccharides and disaccharides that are added to food products by food manufacturers, cooks or consumers. This includes, sugars that are naturally present in honey, syrups and unsweetened fruit juice. Lactose (when present in milk / milk products) and the sugars contained within the cellular structure of foods such as fruits and vegetables are excluded (PHE, 2015c; WHO, 2015c).

The term, 'free sugars', replaces 'non-milk extrinsic sugars' (NMES), a term which was used in the UK for 25 years. Although very similar, 'free sugars' are the types of sugars which need to be reduced in the diet. The difference is that they don't include sugar

from dried, stewed or canned fruit (BNF, 2015). Indeed, the only difference between NMES and free sugars is that NMES includes 50% of the fruit sugars from stewed, dried or canned fruit but free sugars includes none (PHE, 2015c).

SACN have recommended that the DRV for carbohydrates is maintained at a population average of 50% of the total dietary energy intake (SACN, 2015a).

3.3.3 Consumer sugar consumption data

SACN recommend that sugar intake should not exceed 5% of daily intake from total energy intake (PHE, 2015b). However, as illustrated in Table 5, all age groups consume a daily quantity of sugar, which is greater than the recommended intake for 'free sugars'. Children and teens have exceeded this recommended intake by over 15% in some instances, by consuming almost 75g of 'free sugars' in one day. All age groups exceeded intake by at least 20g, which is two-thirds on top of recommendations (PHE, 2014a).

Table 5: Comparison of recommended maximum intake and consumption of sugar (adapted from PHE (2015b) and sugar intake measured as NMES from PHE (2014a))

Age group (years)	Recommended maximum daily intake (% of food energy per day)	Recommended maximum daily intake (g per day)	Sugar intake (g per day)	Food energy intake from sugar (% per day)
1.5 to 5	5	<19	36.1	11.9
4 to 10	5	<19-24*	60.8	14.7
11 to 18	5	30	74.2	15.6
19-64	5	30	58.8	12.1
65+	5	30	51.6	11.5

*24 refers to children aged 7-10

Non-alcoholic beverages are the main source of sugar intake for all groups. Cereals and sugar preserves are also high contributors, providing 72 to 81% of total sugar intake. The most concerning sugar intake involved teenagers, with soft drinks (excluding fruit juices) contributing to 40% of sugar consumption (PHE, 2015b).

Table 6: Sources of 'Free sugars' as percentage of daily intake (PHE, 2014a)

Age group (years)	Non-alcoholic beverages (%)	Cereals/Cereal products (%)	Sugar preserves & confectionery (%)	Milk products (%)	Alcoholic beverages (%)
4 to 10	30	29	22	12	N/A
11 to 18	40	22	21	7	N/A
18 +	25	21	26	6	10

A review of dietary intake data and household food expenditure in Great Britain from 1986 to 2009, reports on an increased consumption of fruit juices and reduced-fat milk among pre-schoolers, children and adolescents. Among adults, consumption of alcohol (particularly beer) and fruit juice increased (Ng *et al.*, 2012).

Although not significant, it has been determined that the mean intake of NMEs tended to be slightly lower in most age/sex groups in Wales compared with the same groups in the UK as a whole (Food Standards Agency in Wales *et al.*, 2015). Nevertheless, mean NMES intake amongst consumers in Wales, exceeded the DRV among all age/sex groups other than older adults (aged 65 years and over). Amongst children, the main sources of NMES were soft drinks and fruit juices. Other major contributors to children's NMES intake included cereal products, buns, cakes, pastries, biscuits, sugar, preserves and confectionery. Similar contributions were determined among adults. For older adults, 'buns, cakes, pastries and fruit pies' and 'table sugar, preserves and confectionery' were major contributors to NMES (Food Standards Agency in Wales *et al.*, 2015).

3.3.4 Sugar reduction recommendations and initiatives

Although sugar can be replaced with sweetener, the scientific and public health communities are divided on the issues. It is argued that although sweetener can have a positive action in reducing calories and associated health risks, it does not reduce consumer preference for 'sweet' products. The debate lies between whether sweetness or calories should be reduced and whether consumers should adapt to consuming food products which are less sweet (The Sugar Reduction Summit, 2015). Recommendations from WHO (2015a) on reducing sugar intake include:

- limiting the consumption of foods and drinks containing high amounts of sugars (e.g. sugar-sweetened beverages, sugary snacks and candies); and
- eating fresh fruits and raw vegetables as snacks instead of sugary snacks.

3.4 Food, Health and Nutrition Policy, Strategy and Consumer Education Intervention Initiatives

Nutrition policy development is complex and political as policies may benefit or threaten different sectors and challenge food cultures and domestic food habits. UK policy regarding food has a varied past. The policies established during war time,

ensured that during food shortages, everyone would receive food and it was considered successful on the basis of improving civilian mortality rates (Murcott *et al.*, 2013). More recent policy focuses on the prevention of overweight and obesity as opposed to underweight and malnourishment.

It is suggested that the development of nutrition/food based policies may provoke opposition in prescriptive measures from the food industry (Oddy & Atkins, 2012). However the food industry has taken action to reduce the risk of obesity and food-related health issues through product reformulation.

Awareness campaigns and education strategies aim to empower consumers to adopt healthier eating habits. This often starts by raising individuals' awareness of the issue, then providing information about alternatives and providing the support to help the individual make a more health beneficial choice (Hawkes, 2013).

The provision of healthier food is a key Welsh Government policy across a wide range of settings, specifically recommending:

- The avoidance of processed meat products which are high in fat and salt in early years settings (Welsh Assembly Government, 2009);
- Avoiding red traffic light labelled foods in hospital vending machines (Welsh Government, 2012c);
- Cutting down on foods high in saturated fat in foods provided at leisure centres (Welsh Government, 2012a);
- Provision of free breakfast in primary schools, in which it is suggested that children should be encouraged to use fresh fruit and dried fruit as sweeteners for cereals, and served vegetables must not be fried (Welsh Government, 2014)
- Cutting down on foods high in saturated fat in foods provided in youth work settings (Welsh Government, 2012b); and
- Rewarding workplaces which limit unhealthy food options in vending machines. For example, the Gold Corporate Health Standard Award requires that healthy snacks and drinks make up 75% of vending machine items (Welsh Government, 2015a).

It is suggested that a combination of approaches including product reformulation and consumer education is required to enable improvement. As discussed by those who developed the Cardiff Food Strategy, the provision of healthy food relies on the co-

ordinated efforts of a number of diverse disciplines. The strategy is said to have increased the uptake of a healthy, safe and sustainable diet for all those living in Cardiff because it constitutes multidisciplinary public health in action (Fairchild & Morgan, 2007). In the case of salt, Cappuccio *et al.* (2011) suggests that changing the personal habits of consumers alone is not an effective action given the majority of salt is found in food products and instead advocates a four-pronged approach of communication, reformulation, monitoring and regulation (Cappuccio *et al.*, 2011).

In October 2015, celebrity chef, Jamie Oliver spoke to the House of Commons Health Committee concerning childhood obesity and whether the Government should intervene further in the diets of children. Mr Oliver presented the Government with his own recommendations to combat the rising levels of childhood obesity in the UK. His recommendations cover six main points (JamieOliver.com, 2015; UK Parliament, 2015):

- children’s health levy (20p levy on sugary soft drinks);
- reformulation (gradual reduction of sugar in food and drink);
- labelling (clearer labelling e.g. traffic lights);
- school food plan (17 actions – including standards for packed lunches);
- ban marketing of unhealthy foods (high fat, salt and sugar foods) to children on television and in-store; and
- national children measurement programme (extend existing programme to pick up early signs of obesity).

A review of public health nutrition policies across the European Union by Lloyd-Williams *et al.* (2014) classified policies using the “4Ps” marketing approach, namely: price, product, place and promotion, as detailed in Table 6. The review concluded that mandatory reformulation may be more effective than voluntary reformulation, and regulation and fiscal interventions much more effective than information strategies but also politically more challenging.

Table 7: The “4Ps” marketing approach applied to public health nutrition policies (Lloyd-Williams *et al.*, 2014)

“P”	Details
Price	Taxes; subsidies; or other economic incentives
Product	Reformulation; elimination or new products
Place	Schools, workplaces or community settings

Promotion	Restricting marketing to children and adults; nutritional food labelling; nutritional information on menus; public information campaigns; and health education
-----------	--

As part of the 'Food for the *Future*' report, the areas of nutrition policy for consideration to improve the food, health and nutrition of people in Wales are categorised as:

- regulation of marketing;
- product reformulation;
- taxation;
- information provision;
- nutritional education; and
- access to healthier food.

3.4.1 Regulation of marketing

Food advertising and other forms of marketing have been shown to influence childrens' food preferences. It is suggested that internationally, the majority of adverts seen by children are for food products with high levels of fat, sugar and salt. The UK's statutory ban on television advertising of foods high in fats, sugar and salt during children's programming was a world first and broke new ground internationally for imposing more stringent conditions on food and drink industries (WHO, 2014a). Although it is reported that the annual expenditure for child-themed food and drink advertisements across all media has reportedly decreased by 41%, between 2003 (£103 million) and 2007 (£61 million) (WHO, 2014a), family entertainment shows are considered as 'adult' programming, and consequently fall outside current regulations. Therefore, children remain exposed to unhealthy food and drink advertisements (WHO, 2013).

It is speculated that an advertising ban and restrictions on promotions are expected to be the focus of the UK Government's Childhood Obesity Strategy. Although originally expected at the end of 2015, the strategy is now expected during 2016 (Perrett, 2015).

Modelling of reducing TV advertising for energy-dense, nutrient-poor foods (high fat and/or high sugar foods and beverages) to Australian children concluded it could be one of the most cost-effective population based interventions available to governments to reduce unhealthy weight gain in children aged between five and 14 years old. The cost-effectiveness of the modelling study suggested that although the BMI change per

child was small, the total health benefit was high because of the large number of children affected and the low cost (Magnus *et al.*, 2009).

As part of this report, it was determined that 63.9% of consumers in Wales believed that a ban on the advertisements of high fat, salt and sugar food product on television before 9pm would encourage the general public to eat healthier. A third (33.6%) believed that it would aid them to eat healthily (See Appendix). However, further research is required to explore and consider the potential negative impact of such actions on advertisement-based revenue.

3.4.2 Product reformulation

It is reported that the voluntary industry action in the UK to reduce the levels of artificial trans-fats in food products has resulted in a drastic reduction in average dietary intakes of artificial trans-fats (FSA, 2007a; SACN, 2007). A cost effectiveness modelling study concluded that in England, a regulatory policy to eliminate trans-fats from processed food would be the most effective and equitable policy option. The study suggested that continuing to rely on industry to voluntarily reformulate products could have negative health and economic benefits (Allen *et al.*, 2014).

Australian modelling data indicate that mandatory and voluntary salt reductions are cost-saving interventions (Cobiac *et al.*, 2010). As described by He *et al.* (2014), the UK salt reduction programme has successfully reduced the population's salt intake by gradual reformulation on a voluntary basis. Since the start of the salt reduction programme in 2003, the salt content in many processed food products has seen a significant reduction of 15%. Consequently, a 15% reduction in sodium consumption, over seven years, has been reported from 9.5g to 8.1g per day (He *et al.*, 2014).

It is suggested that mandatory reformulation would have the largest estimated saving (Collins *et al.*, 2014). However, the potential limitations of reformulation have to be considered, it is reported that the feasibility of reformulation relates mainly to consumer acceptance (van Raaij *et al.*, 2009). There is a need to calculate the potential impact of mandatory reformulation in Wales and the bearing such actions would have on businesses.

Research conducted with consumers in Wales as part of this study (See Appendix), determined that between a quarter and a third of respondents indicated willingness to pay more for food products with reduced salt, fat and sugar content. It was determined

that a significant difference was reported in the desirability between regular and reformulated 'healthier' food products. This could potentially be because their experiences of reduced fat/salt/sugar food products in the past have been disappointing. It suggests that investing more in the technology to make reduced fat biscuits more palatable is important. An alternative suggestion is for 'stealth reformulation', whereby if the fat/salt/sugar content is to be reduced, all consumers would benefit without any of the negative associations of the 'reduced fat/salt/sugar' label.

As indicated in Figure 1, although many respondents had a positive attitude towards the reformulation of food products, some expressed concerns regarding alternatives utilised in reformulation and the potential health impact of such alternatives. Concerns regarding the potential costs were discussed in relation to reformulated food products and suggested a profit-driven mentality from the food industry. Consumers who disagreed with reformulation indicated a need for consumer education interventions to improve nutritional behaviour through informed choice.

"If we know these substances are bad for our health, I think that it is essential this (reformulation) happens."

"For those who will always buy say ready meals and sauces in jars I think this (reformulation) is a good idea on the whole. People may not even realise they're buying a new healthier product so for many this could be a good solution."

"In theory (reformulation is) a good idea as long as the substitutes are genuinely better and don't just swap one bad thing for another."

"The replacements use chemicals which can potentially have a greater impact on the body than the naturally occurring salt, fat and sugar."

"The replacements use chemicals which will cost more to produce which will be passed on to the consumer."

"This would be helpful, however reducing fat/sugar/salt can often compromise taste - customers should be offered a clear choice but not forced into particular options. People should have the option to choose "unhealthy" food once in a while as a treat, though the packaging and labelling should make it clear that these foods should only be considered as an occasional treat by highlighting that they are not particularly healthy."

Figure 1: Consumer responses regarding reformulated food products

Recommendation: Consider commissioning consumer research to enable Welsh businesses to better understand Welsh and UK consumers' perceptions of healthier products and messaging.

The 'Less Salt is Healthier' initiative in Austria (Bundesministerium Für Gesundheit, 2014), and the 'Thai Food, Good Heart' project in Thailand (Supornsilaphachai, 2013),

allows industry to use a health label to indicate a reduced salt content in bread and processed food products that meet certain salt standards. The display of such labels on food products can be informative for consumers to enable informed choice of 'healthier' food products, but also act as a driver for food businesses to pursue reformulation. However, there is a need to obtain an in-depth understanding of consumer perceptions of healthier messaging and reformulated food products.



Figure 2: The 'Thai Food, Good Heart' and the 'Less Salt is Healthier' logos to indicate a reduced salt content (Centre for Science in the Public Interest, 2015).

Recommendation: Consider developing specific initiatives to increase the number of and competitiveness of healthier products in selected categories.

3.4.3 Taxation

In anticipation for the UK Government's Childhood Obesity Strategy, it remains in question if a 'sugar tax' will be incorporated in the strategy as it was suggested that there was little evidence of the long-term impact of such taxation on calorie intake (Perrett, 2015). The British Dental Association (BDA) have been campaigning for legislation to limit the amount of sugary food and drink children in the UK consume and have been lobbying the UK Government on the oral benefits of a 20% tax on carbonated sugary drinks (BDA, 2015a, 2015b). A comprehensive study of trends in UK beverage consumption patterns identified an increase in the consumption of all sugar-sweetened beverages across all age groups. Modelling, conducted as part of the study, suggested that higher prices for sugar-sweetened drinks would result in a reduction in their purchase and is suggested as a potential method to improve soft drink choice in the UK. The researchers calculated that a 10% increase in the price of sugar-sweetened drinks could potentially result in a decrease of 7.5ml/capita per day (Ng *et al.*, 2012).

A review of salt reduction initiatives around the world published by Trieu *et al.* (2015) identified taxation on high-salt foods in Fiji, Hungary, Portugal and Hungary (Trieu *et al.*, 2015). It is suggested, from a Norwegian modelling-study, that the taxation of high-salt foods may increase life expectancy. It is suggested that the cost effectiveness of a salt taxation would be similar to that of information campaigns and the development of new food products (Selmer *et al.*, 2000).

Consumers in Wales indicated as part of this report (See Appendix), that more than half of respondents believed that a tax on sugar-sweetened drinks (57.4%) and the availability of cheaper diet and sugar-free alternative drinks (52.5%) would aid the general public to reduce sugar consumption. Although many Welsh consumers believed that the Welsh Government could improve food-related health through taxation of 'unhealthy' food products and cheaper availability of 'health' food, some consumers believed that there was a need to tax food producers and not the consumer (Figure 3).

“Tax the food producers who make this unhealthy rubbish processed food. Educate children in schools, provide healthy food for school lunches and hospital meals.”

“Insist that food manufacturers make the healthiest version of their foods possible. Tax high sugar foods and drinks. Label alcoholic products.”

“The Welsh Government should get its act together, introduce in future very high taxes on junk food in future and highly regulate the takeaway industry. In addition establish a powerful health eating initiative across all sectors in Wales and investing in local primary and secondary healthy food production businesses. Draconian maybe, but what's the alternative, generations of chronic obesity and huge health deficit to deal with.”

“PopTax!”

Figure 3: Consumer responses regarding taxation of food products high in fat, salt and sugar

An in-depth review was conducted to assess the effect of food taxes and subsidies on diet, body weight and health. In general, taxes and subsidies influence consumption in the desired direction, with larger taxes being associated with more significant changes in consumption, body weight and disease incidence. However, studies that focused on a single target nutrient may overestimate the impact of taxes by failing to take into account shifts in consumption to other foods. The quality of the evidence was determined to be low and suggests a need for in-depth research to determine the effectiveness and differential impact of food taxes (Thow *et al.*, 2010).

3.4.4 Information provision

Nutrition labelling is regulated at a European level by the Regulation (EU) No. 1169/2011 on the provision of food information to consumers (EU FIC). Mandatory (back-of-pack) nutrition declaration is enforced by legislation throughout the UK (DoH, 2015a). In Wales, this is enforced by the Food Information (Wales) Regulations 2014 (Welsh Statutory Instrument, 2014) and the Food Labelling (Nutrition Information) (Wales) Regulations 2009 (Welsh Statutory Instrument, 2009).

The Governments of the UK and the FSA worked in collaboration with the British Retail Consortium (BRC) to develop a traffic light labelling system to indicate to consumers the energy content and the levels of fat, saturated fat, sugar and salt in food products. These voluntary front-of-pack (FOP) labels provide colour coded nutritional information to consumers, which are provided in addition to the full mandatory back-of-pack nutrition declaration. The purpose of the traffic lights is to enable consumers to make healthier choices quickly and easily when purchasing food and drink products (DoH, 2013a; FSA, 2007b).

The Food Information to Consumers (EU FIC) regulation was launched EU wide in 2011. However, the nutrition labelling changes do not have to be implemented until December 2016. Businesses can continue to voluntarily display FOP nutrition information, but they must take the form of either energy only, or energy plus the amount of fat, saturates, sugars and salt per food product serving/portion and the energy per 100g in kilojoules. Furthermore, the guidance also states that graphics, colours or additional text can be used, but the format must be scientifically-based and not mislead the consumer (DoH, 2013c; FSA, 2014a). However, as FOP food labelling remains voluntary, it is suggested that food and drink businesses in many other EU member states believe front-of-pack nutrition information to be a commercial disadvantage. Indeed, prior to its adoption it was suggested that there was no evidence that use of one type of FOP nutrition information generates any competitive advantage and it was questioned if responsible brand owners would be left at a competitive disadvantage by voluntary adoption (FSA, 2010b). Consumer testing of the acceptability and effectiveness of FOP food labelling systems for the Australian grocery market, determined that the system was the most effective in assisting consumers to identify healthier foods (Kelly *et al.*, 2009).

A study to determine the impact of FOP 'traffic-light' nutrition labelling on consumer food purchases in the UK, determined that the introduction of traffic-light labels had no discernible effect on the relative healthiness of consumer purchases (Sacks *et al.*, 2009).

Further research on the influence and performance of FOP nutrition information is required before they can be considered a promising public health intervention and prior to any move to make FOP labelling compulsory (Hamlin *et al.*, 2015; Sacks *et al.*, 2009).

When prompted, the majority (75.4%) of those that participated in the survey as part of this report indicated that they would 'always' / 'sometimes' take notice of FOP traffic-light nutritional information. Public health interventions believed to have/would have an impact to enable the general public to eat healthier included the use of FOP traffic light nutritional labelling on food products purchased from supermarkets (45.4%) and inclusion of traffic light labelling on menus when eating out (35.8%) (See Appendix).

Recommendation: Consider reviewing the level of uptake by Welsh companies and assess compliance with the recommended format for front-of-pack nutritional labelling and consider supporting those companies not currently complying.

It is suggested that including information on the grams of fat per item on restaurant menus in the USA resulted in consumers selecting an average of 1.5g less fat than compared to when no information was provided. However, for such information on a menu to result in behavioural change, consumers need to notice the information, understand the information and then use the information to inform their menu choice. It was suggested that 71% noticed the information and of those, 59% acted on it in some way (Pulos & Leng, 2010). The use of nutritional labelling on food products in a university dining hall was determined to positively impact food choices. A significantly higher percentage of women reported using nutritional labelling to determine food choice (based upon calorie counting and concern about certain nutrients). However, some consumers indicated that such labelling would not change their mind about food selection and attributed this to insufficient time to view (Driskell *et al.*, 2008). The results of a study on the influence of health claims and nutrition information on

consumers' evaluations of packaged food products and restaurant menu items indicate that when favourable nutrition information or health claims are presented, consumers have more favourable attitudes toward the product, nutrition attitudes, and purchase intentions (John C. Kozup *et al.*, 2003).

As part of the Healthy Food Code of Good Practice, the FSA summarised the challenge to all sectors of the food industry to promote healthy eating. The code sets out seven areas detailing where food companies can take action to demonstrate their commitment to promote healthy eating. These included nutritional information on food eaten out of the home. The FSA reported that calorie information could be included on the menus of many food outlets including workplace canteens, sit-down and quick-service restaurants, theme parks and leisure attractions, pub restaurants, cafes and sandwich chains. It was suggested that making calorie information available at the point of choice is the first and simplest step to enabling an informed and healthier choice when eating out (Cross-Government Obesity Unit for England, 2009; FSA, 2008, 2009).

In Finland, food products that are high in salt are required to carry a 'high salt content'. It is suggested that measures have contributed to a significant reduction in salt intake of the Finnish population (He & MacGregor, 2009).

Health warning labels on sugar-sweetened drinks are reported to improve parents' understanding of health harms associated with overconsumption of such beverages and may reduce parents' purchase of such drinks for their children (Roberto *et al.*, 2016; ScienceDaily, 2016). Legislative bills have been introduced in California (Senate Bill No. 1000, 2014) and New York State (Senate Bill No. A02320, 2014), which require the display of health warning labels on sugar-sweetened drinks.

It was determined that between a half (51.6%) and three-quarters (77.0%) of consumers in Wales that participated in the survey for this report, believed that providing imagery information on sugary drinks would aid consumers to consume less sugar. The preferred method was providing information on sugar content and better alternatives, indicating that diet alternatives contain no sugar (77.0%) (See Figure 4 – Image B), as opposed to a 'health warning' (See Figure 4 – Image C).



Figure 4: Imagery on sugary-drinks to aid consumers to consume less sugar

3.4.5 Nutritional ducation

Educational efforts can be based at school, in the community or tailored for individuals. However, modelling data suggest that the provision of targeted dietary advice is not a cost-effective method (Cobiac *et al.*, 2010). It is suggested in market research data that negative media attention on the high sugar content of fruit juice and smoothies may be having an undesirable impact on the market. One in five consumers are said to limit purchase due to sugar content (Mintel Group Ltd., 2014). To prevent a negative impact on the food industry, the implementation of nutritional education is required to enable consumers to make informed choice regarding food consumption.

In the USA, family based interventions have been utilised. The US Expanded Food and Nutrition Education Programme delivered 6-8 hours of nutrition education lessons over 4-6 weeks to 13,430 families. The federally funded nutrition education intervention for low-income families, which measured the economic impact of nutrition education by using behaviour change, was deemed to be cost effective; for every US\$1 spent on nutrition education, at least US\$3.67 was saved. This included direct benefits such as, postponed health care costs due to the delay of chronic diseases and indirect benefits such as increased productivity due to a healthy lifestyle. Optimal nutritional change for eight chronic diseases/conditions were identified (Joy *et al.*, 2006). Studies have shown that some Expanded Food and Nutrition Education Programme families who attain optimal nutritional behaviours maintain them for five years following the nutrition education. Documentation of retention for more than five years has not been published (Joy *et al.*, 2006).

Mass media campaigns can be utilised to encourage consumer behaviour change. Although costly to implement, broader exposure and greater message reinforcement can be achieved. Wootan *et al.* (2005) reviewed the effects of four strategies to encourage consumers to switch from high-fat milk to '1% fat or less' milk and it was determined that paid advertising and media relations were the most cost-effective way of triggering dietary change rather than community based education (US\$0.57 versus US\$11.85 per person) to elicit a change in behaviour. Community based education included activities such as blind milk taste tests, point-of-purchase signs in shops, nutritional seminars and school activities. However, the combination of paid advertising, media relations and community-based educational activities resulted in the greatest percentage of surveyed individuals that switched milk product choice (30%) (Wootan *et al.*, 2005).

The NHS Change4Life campaign involves TV promotion and help and advice for improving the nation's health. 'Change4Life' is promoted in England, 'Change4Life Wales' in Wales, 'Eat Better, Feel Better' in Scotland and 'Get a Life Get Active' in Northern Ireland. In January 2014 and January 2015, campaigns were launched which focused on reducing sugar, 'Smart Swaps' and 'Sugar Swaps', aims to educate consumers on the levels of free sugars in food, advising on ways to reduce sugar in a user friendly, simple manner such as swapping sugary drinks to "sugar-free", "diet", "no-added-sugar" drinks, milk or water (PHE, 2014b, 2015a). Purchase data showed a reduction of 8.6% in carbonated sugary drinks during the 'smart swap' TV campaign from January 2014 (Kantar Worldpanel, 2014).

Education and support meetings for individuals are reported to be effective in aiding weight loss. A randomised controlled trial of post-menopausal women at high risk of breast cancer, determined that support meetings to encourage a low fat diet, significantly reduced the hazard ratio for breast cancer (Bos *et al.*, 2011). Similarly, the Lyon Diet Heart Study involved an intervention delivered either by a Dietitian or Cardiologist to encourage individuals to adopt a Mediterranean-style diet. The intervention group had a significantly ($p < 0.01$) reduced risk of cardiac deaths (0.41 per 100 patients per year) compared to those of the control group (1.37 per 100 patients per year) (de Lorgeril *et al.*, 1999).

It is also suggested that nutrition based interventions can be effective without face-to-face contact. A study on the cost-effectiveness of a telephone-delivered intervention

for physical activity and diet, determined that telephone counselling over 12 months had a statistically significant effect, with a 1.17% reduction in percentage calories from total fat compared to baseline data (Graves *et al.*, 2009). An internet-based, tailored feedback intervention, was determined to significantly improve self-reported fat intakes and actual lipid levels (Papadaki and Scott, 2005). Similarly, automated tailored dietary advice was found to reduce saturated fat intakes in a group of Australian consumers who usually bought groceries online. The intervention involved recommending specific switches from selected high saturated fat products to lower saturated fat alternatives. Compared to the control group, the intervention produced a statistically significant, 10% reduction in saturated fat purchases (Huang *et al.*, 2006). E-mail counselling to a basic internet weight loss intervention program was proven to significantly improve weight loss in adults at risk of diabetes (Tate *et al.*, 2003).

The role of the Welsh Government in aiding the general public to improve their food-related health was discussed by many respondents that participated in the survey, which was conducted as part of this report (See Appendix). Comments included recommendations for food-related health education, discussions relating to education concerning portion size, cooking skills, food procurement and where food comes from. Although some indicated a desire for literature, others did not, suggesting some consumers may not take note (Figure 5).

“Much of Wales’ obesity problem starts in the early years which is totally the responsibility of parents. They need better educating. I believe it’s also linked to the high rates of poverty in Wales as well. Publication of cheap, healthy recipes and marketing campaigns with influential sports personalities may also help.”

“Consumers need to change their eating behaviour and usually buy brands that have been advertised. Manufacturers and advertisers along with government food regulators have to rethink and control ingredients that harm our health causing obesity, arthritis and diabetes. NHS would benefit too with a healthier nation. Eyes are bigger than our bellies and in time the nation could get used to less sugar, salt and fat. Bring it on please ASAP. A gradual process change to levels of sugar preferably so the body adapts and not goes into shock. This survey is most definitely essential and thank you.”

“Make a user friendly website which has sections for everyone’s dietary needs (religious, vegetarian, maybe even nutrition advice for people who gym a lot) which helps them find info about what they are eating, what affect it has on their body and diet tips. Other than this, it’s the individual’s responsibility to eat healthy, and tax payers’ money of people that do eat healthy shouldn’t be wasted on those that don’t.

“More food, weight and health clinics on the NHS open to all. Better to spend on prevention rather than the expense of treating problems.”

“Perhaps use shock tactics in short information films showing what happens when taking too much salt/sugar/fat. Emphasising the impact it has on the economy

regarding treatment for diabetes and other eating disorders created through overeating and obesity.”

“Promote the Heathy Options Scheme run by a few councils. Ban sale of fizzy drinks in schools etc. Weight watchers or similar groups on prescription for overweight people. Requiring GPs to tell people they are overweight and address the issue with them. Definitely not more health promotion! We've been leafleted and lectured to the point no one listens.”

“To be a healthier nation we need to be taught and encouraged more to eat a balanced diet and exercise more. I know exactly what I should and should not eat but I just cannot stick to a diet - more time and money should be invested in helping people 'stick' to things. It's very easy to encourage and start new initiatives - it's the keeping to it that's the challenge. Free diet classes would be good or a mentoring system where you get a weight loss buddie. Weekly weighing does help.”

“Portion control. No one explains what a healthy portion is.”

Figure 5: Consumer responses regarding nutritional education

3.4.6 Access to healthier food

Not only do consumers need to be subjected to educational initiatives to enable nutritious behaviour change, consumers also need to be able to access ‘healthier’ food products. Access to ‘healthier’ food products can be influenced by living location, accessibility to food retailers and also by financial constraints. Data indicate that those living in the most deprived areas of Wales have the greatest consumption levels of NMES, lowest NSP, lowest micronutrient intakes and lowest consumption of fruit, vegetables and oily fish (Food Standards Agency in Wales *et al.*, 2015). The Family Food report compared household consumption, in comparison with Eatwell recommendations and it was determined that consumption of fruit and vegetables was lowest in low-income households. The report also determined that the consumption of food and drinks high in fat and/or sugar was far greater (24%) than recommendations (8%) (DEFRA, 2015)

It is suggested that having suitable shops in low-income or deprived areas creates a healthier food environment as it can support healthier choices by having convenient and regular access to grocery stores or food markets, which sell fruits, vegetables, and other foods at affordable prices to enable consumers to eat well (Bell *et al.*, 2013).

The consumption of fruit and vegetables across Europe is reported to be decreasing with children, on average, consuming between 30% to 50% of the recommended daily intake of fruit and vegetables. Consequently, the School Fruit Scheme was launched in 2009/2010. The scheme includes the provision for education to promote the consumption of fruit and vegetables (European Parliament News, 2016). European

funds of €90 million annually are provided to purchase and distribute fresh fruit and vegetables to schools. The School Fruit Scheme aims to encourage good eating habits in young people, which studies show, tend to be carried on into later life (European Commission, 2015). Currently, of the 28 EU member states, the UK, Finland and Sweden are the only states not to participate (European Parliament News, 2016). It may be suggested that Wales should participate in this scheme.

As discussed in the Introduction of this report, consumption of fruit and vegetables in Wales is below the recommended levels. Respondents in the Food for the *Future* survey (See Appendix) suggested that the availability of free fruit and vegetables and access to ‘healthier’ food products, would enable consumers to engage with healthy eating initiatives (Figure 6).

“More educational information sources and initiatives that people can get involved in. Pop up stands/shows of free fresh fruit and veg in public places/events. Be more explicit in the health initiatives and really hit home to people that we should all be a bit more thinner.”

“Healthy food should be cheaper than fat, convenience foods.”

“Ban sale of fizzy drinks in schools.”

“Fresh produce should be cheaper. It’ll lead to a healthier, fitter and more productive nation and less strain on the NHS.”

“Enforce manufacturers suppliers etc. everyone to push for ready-made food to be healthier and to make fresh good quality food prices affordable.”

“Give me money to buy healthier food.”

“Greater access to healthy options. Cheaper prices for healthy food.”

Figure 6: Consumer responses regarding availability of healthier foods.

Recommendation: Consider the potential for partnership with business to increase fresh and/or frozen fruit and vegetable sales in convenience stores in catchments without easy access to supermarkets or independent fruit and vegetable retailers.

3.5 Food, health and nutrition intervention development

To enable successful health behaviour interventions, social cognition models are commonly used to develop health education programmes (Rutter & Quine, 2002). The utilisation of such models can enable health educators to provide a framework for effective risk communication to consumers. It is suggested that the efficacy and effectiveness of health promotion interventions can utilise models to achieve improved health outcomes and health behavioural changes. Many models exist and each

consist of various components, some of which are shared, others are unique (Taylor *et al.*, 2006).

The Health Belief Model suggests that risk-reducing behaviours are more likely to be implemented when four key perceptions are addressed. These include the perceived susceptibility to the risk, the perceived severity of the risk, the perceived benefit of implementing an action and the perceived barriers to implementing the action (Janz & Becker, 1984).

The Theory of Reasoned Action (Ajzen & Fishbein, 1980) and the Theory of Planned Behaviour (Ajzen, 1991) propose that behavioural intentions are influenced by attitudes and subjective norms relating to the behaviour. However, the latter theory additionally suggests that perceived behavioural control can also influence intentional behaviour (Madden *et al.*, 1992).

The Health Action Process Approach consists of five principles, in which it is suggested that a difference exists between pre-intentional motivation that leads to a behavioural intention and after which, post-intentional volition allows for the adoption and maintenance of the behaviour. The approach is suggested to overcome limitations that occur within other models of health behaviour and emphasises the role of perceived self-efficacy at different stages of behaviour change (Schwarzer & Luszczynska, 2008).

Given that social cognition models assume that the behaviour of a person is determined by underlying factors, increasingly, such models are being used to understand consumer behaviour. It may be suggested that the application of such behavioural models may be utilised to enable behavioural change among food and drink manufacturing and processing businesses in Wales. There is a need for in-depth research to obtain an understanding of the knowledge, attitudes, self-reported practices and perceptions of the food industry in Wales with regards to food health, nutrition and reformulation.

The application of social cognition models, such as the Theory of Planned Behaviour or the Health Action Process Approach, would enable the development of psychosocial interventions. To enable this, there is a need to utilise consumer cognitive and behavioural data as identified in this report to allow for a full exploration of how food, health and nutrition interventions can be developed to assist in changing

consumer behaviours. To successfully design and develop educational initiatives to communicate the risks associated with the behaviours that need changing, a social marketing approach can be utilised.

An integrated approach to policy making and interventions, involving all stakeholders including consumer education, NHS, food industry, policy makers, health professional, academics and the trade channels, is required.

The World Cancer Research Fund International has developed the NOURISHING framework, which provides an effective approach to develop policies to promote healthy diets. The NOURISHING framework has three key domains, namely food environment, food system and behaviour change communication. Within each, examples of potential policy interventions are detailed (Hawkes *et al.*, 2013):

Food environment:

- Standards and regulations on the use of claims/implied claims on nutrition labels;
- Set standards in public institutions for the availability of healthy foods;
- Affordability and purchase incentives for healthy foods;
- Restrict food advertising that promotes unhealthy diets in all forms of media;
- Improve the quality of the food supply through reformulation; and
- Set incentives to create a healthy retail environment.

Food system suggests

- A need for supply-chain incentives for production; public procurement policies for multi-sector engagement to ensure coherence with health.

Behaviour change communication:

- Public awareness activities to inform consumers about food, health and nutrition through mass media and social marketing campaigns;
- Nutrition advice and counselling to 'at-risk' consumers in health care settings and the development of clinical guidelines for health professionals on effective nutrition interventions; and
- Develop nutrition education through cooking skills and health literacy programmes.

This is a useful framework in which to develop policy in this complex arena.

As the majority of food consumed in Wales is not produced in Wales, policies directed at the Welsh manufacturing sector will have limited impact on the overall health of the population. Ideally, food policies which have the most impact on Welsh health and diets, will be those that influence at the point of purchase or consumption (i.e. retail or food-service) and/or influence food manufacturing outside of Wales. The former is probably most realistic (but still challenging) and the latter will only be achieved through close collaboration with other policy makers and players in the industry, outside of Wales. Incentives in this respect to food manufacturers in Wales to produce healthier foods will, therefore, have little impact on the health of the Welsh population.

Recommendation: Engage with trade channels (e.g. supermarkets, food-service and public procurement) to understand their priorities for encouraging their customers to have healthier lifestyles in order to develop joint initiatives for implementation in Wales.

Recommendation: Consider the feasibility of developing a research programme to develop an improved understanding of the in-store factors that influence consumer behaviours (e.g. packaging design, merchandising, location in-store, pricing, promotional space) in order to inform suppliers and retailers on how to increase sales of healthier products and categories.

4. Element Two: Fat, salt and sugar, does industry have a part to play?

Towards Sustainable Growth: An Action Plan for the Food and Drink Industry 2014-2020 has the development and growth of the Welsh food sector as a key priority. The aim is for the food and farming priority sector to increase turnover by 30% to £7 billion by the year 2020. Additionally, the Food for Wales, Food from Wales 2010-2020 Strategy set out a wide-ranging vision to nurture a food sector which can provide food that is sustainable, safe, affordable, healthy, of the highest standard, with positive social benefits and the lowest environmental impacts.

4.1 The role of fat in food production

The role of fat in food products is to provide energy and fat-soluble vitamins, as taste carriers and fats also play a role in heat transfer and water activity of a food product, and contribute to the consistency, texture, volume and mouth sensation of food products (European Commission, 2009; European Food Information Council, 2010). The functionality of fats in food products include (European Food Information Council, 2014; Sahi *et al.*, 2013);

- Aeration – achieved by trapping air in fat-sugar mixtures to give a stable foam that give cakes and mousses a risen texture;
- Coating – coating flour particles with fat to prevent them from absorbing water to give the crumbly texture in pastry and biscuits;
- Flakiness – during cooking, fat melts between layers of gluten and starch in dough to give air pockets, the liquid steams and causes the layers to rise giving the flaky characteristics of flaky or puff pastry;
- Moisture – fats aid food products to retain moisture content, this can increase its shelf life based on quality;
- Glazing – the glossy appearance achieved when fat is added to hot vegetables, and the addition of fat to add shine to sauces known as “monter au beurre”;
- Plasticity – solid fats soften over a range of temperatures and do not melt immediately, the fatty acids can be rearranged to adjust the melting point, this

can be utilised to produce products such as cheese spreads that spread straight from the fridge;

- Heat transfer – when deep fat frying, the surrounding fat acts as an efficient heat-transfer medium to achieve cooking; and
- Volume - A small amount of fat is added in bread production to improve volume and to give a finer and more uniform crumb structure. Often referred to as bubble stabilisation.

4.1.1 Fat reduction and replacement products

Alternative ingredients utilised for replacing fat in food products are commonly protein or carbohydrate based. These include, potato, corn, chicory roots, egg, soy or milk, which can mimic the properties that fat brings to food (Jiménez Colmenero, 2000).

Protein-based fat replacers can provide a creamy mouth feeling, similar to fats, through the microparticulation of protein into spherical particles to enable protein to function as a fat replacer. The microparticulated whey protein 'Simplese', is used as a fat substitute and it is reported that it can be utilised to give an 80% reduction of oil in the production of American-style cake muffins without a significant impact on the sensory attributes (Bosman *et al.*, 1996).

Water-in-oil and gel-in-oil emulsions, such as reduced fat margarine and spreads can be utilised to enable the development of reduced fat food products such as cakes and biscuits. Emulsifiers are used with water to replace part or all of the shortening (fat) content in cake formulations. Research conducted by Campden BRI has demonstrated how water-in-oil emulsions can be utilised to gain a 50% reduction in shortening, although the water activity of the cake remained the same to give a predictive mould-free shelf life. However, a reduction in cake volume was observed (Speirs & Bishop, 2013). As discussed by Campden BRI, the main issues relating to the reduction and replacement of fat with a substitute can have a negative impact on some sensory qualities such as volume and appearance, and shelf life. Consequently, there is a need for suitable replacements that are capable of matching the functional properties provided by fat (Speirs & Bishop, 2013).

Carbohydrate-based fat replacers use carbohydrate polymers and dietary fibres to replace fat. These include cellulose, poly-dextrose, hydrocolloids and modified starches. These carbohydrate-based fat replacers facilitate a modification in the

rheology of the aqueous phase of products rather than through any direct action on lipids (Speirs & Bishop, 2013).

Recommendation: Explore the possibility of establishing a world leading healthier product reformulation capability in Wales.

Lee and colleagues evaluated the use of oat-glucan amylopectins as a carbohydrate-based fat substitute in a cake system. An increase in gravity (ratio of the weight of a set volume of cake) and a decrease in the viscosity of the cakes were determined as greater quantities of shortening were replaced. In cake production, 20% of shortening could be replaced with oat-glucan amylopectins such as 'Oatrim' without a significant impact on the physical properties of the cake (Lee *et al.*, 2005).

Similarly, replacing up to 70% of fat with inulin (Rodríguez-García *et al.*, 2012) or up to 50% of fat with guar gum or xanthan gum (Zambrano *et al.*, 2004) has no adverse effect on sensory properties.

In the USA, the Food and Drug Administration requires the labelling of trans-fats. This requirement has resulted in many foodservice operators eliminating the use of trans-fats. Given the different oils available to reformulate deep-fat frying, foodservice operators need to select which attributes are most important; stability, usage, cost, nutrition, or taste preference (Hack *et al.*, 2009).

4.1.2 Industry fat reduction efforts

As described in the case studies (see Figure 7), an Independent Product Innovation Specialist describes her experiences of reformulation with a food manufacturer to enable a fat reduction by the utilisation of starch. Factors, such as taste profile and customer expectation are discussed along with clean label declarations. However, no negative impact was determined when starch was added. The time required to enable product reformulation is also discussed. However, benefits regarding reformulation are identified, which include cost savings from lower-priced raw materials and reduced wastage, improvements in product quality resulting from less fat separation resulting in quality maintenance throughout shelf-life. Retail brand restrictions regarding additives were identified as reformulation barriers.

A global manufacturer of dairy based ingredients has undertaken reformulation work, with the focus of reducing fat levels in their finished product, by utilising the application

and addition of starches. The manufacturer indicated that whilst reformulation success was achieved from a food chemistry perspective, initial development work has been hindered, not by the inability to reduce or remove fat from the foods chemical composition, but more so by consumer attitudes towards food products with added ingredients. Clean ingredient declaration “natural” labelling is being driven by consumers.

The food manufacturer has successfully launched around six reduced fat dairy products into the market place since 2013, including dairy sauces, cheese sauces, low fat crème fresh etc. Many of these product offerings are widely available in the supermarkets and are key in offering the consumer more choice as reduced fat alternative to some of the core lines available on the retail shelves.

The recipes have been specifically reformulated, often over a development time-line of up to nine months per product, to replace some of the high fat yielding ingredients i.e. butter, cream etc., with lower fat alternatives, in order to deliver finished products with an overall added value such as reduced fat, which appeals to some consumers buying groups.

The reduced fat products are often positioned side by side on the retail shelves with their higher fat content rivalries and alternatives and remain cost competitive in the market place. Some cost savings were found during the development of these products where lower priced raw materials were used as the fat replacers yet the overall finished product price was not changed.

During the reformulation, additional benefits were also observed in relation to product quality over the duration of the product shelf-life. Less separation of the fats in emulsion and variation in flavour was observed making the product more aesthetically acceptable, which is especially important when the product is nearing end of life. Another positive outcome from the reformulation was a reduction in raw material wastage was observed.

The reformulation resulted in a change of label declaration for the product, as starch was being used as an added ingredient; this needed to be declared on the label. This change was seen as acceptable by the retailers and consumers alike and no negative feedback was received as a result of the additional ingredient. Alterations to the taste profile of the product must also be considered as a key driver when reformulating products either to achieve a positive improvement or to avoid loss of flavour and taste. There should be no notable difference in the taste of the product after reformulation.

There are also some barriers to consider when reformulating food products, including retailer brand restrictions i.e. where it is specified that certain additives or ingredients cannot be used, as well as consumer perception in relation to additives, “Once a category ingredient gets a bad name or bad press it goes on the not to use list”.

Figure 7: Claire Talbot – Independent Product Innovation Specialist, fat reduction in crème fraiche

The Independent Product Innovation Specialist also described reformulation activity in reducing the fat content of fish coatings. The time to reformulate the product was lengthy and the project lasted 12 months. Cost was discussed to be a potential barrier to the success of the product. Although the new product had an increase in price due to reformulation, it was off-set by reduced oil usage (see Figure 8).

Ten products were reformulated to reduce the oil pick up for a ‘Fish and Chip’ style coating which was used to deep fry products in the Food Service sector. One single coating system was developed and launched which achieved a 25% reduction in fat uptake on frying.

Traditional ‘battered’ products have variable fat levels. It is difficult to control the level of ‘oil pick up’ during the frying process as there are many variables to consider and balance such as water content, oil temperature and fish water content. However, an

innovative coating system was developed to prevent fat absorption into the coating when fried. The product was reformulated over a 12 month period and is an established brand in the food service sector currently and is planned to be promoted via a national advertising campaign.

The product was well received by lunch time restaurant consumers; it was the most popular choice for consumers who wanted a 'light bite' i.e. a healthier option. It was marketed and sold at a premium price to the caterer, the increase in price was off- set by a reduction in oil usage.

The product was designed to meet a strict brief and it met the requirements on shelf life, sensory profile, food safety and legal labelling. The greatest barriers to the success of the product was the increased selling price to the customer from the manufacturer and the end consumer accepting a new concept as they expected the new product to look like traditional fish and chips. This product was first to market and set the bar high for competitors to match.

Traditional food markets struggle with change. The consumer expects, especially with branded products, a specific flavour, texture, appearance at a value for money price. New products have a different entry level of expectation by the target consumer. However, ultimately products are only successful if they look good, taste good, and have an acceptable texture and shelf life.

Figure 8: Claire Talbot – Independent Product Innovation Specialist, fat reduction in deep fried coating system for fish

4.2 The role of salt in food production

Salt's primary food functions are varied due to its low cost and wide availability (Albarracín *et al.*, 2011). Traditionally, salt has been used as a preservative or to enhance flavour in home cooking. Salt has many roles in modern day food manufacturing. Salt is used in the manufacturing process to prevent spoilage and extend shelf-life and it is an effective preservative as it lowers the water activity of foods by the ability of sodium and chloride ions to associate with water molecules (Henney *et al.*, 2010). This association of salt and water in food causes microbial cells to lose water by osmosis, resulting in apoptosis thus preventing the growth of microbes. Its use as a preservative and antimicrobial agent in food is as a direct consequence of the capacity of sodium chloride to reduce water activity. In addition, sodium chloride is a flavour enhancer (Albarracín *et al.*, 2011).

Salt not only adds flavour to cheese, it also plays a role in cheese production through osmosis. The salt further draws the whey out of the curd by osmosis and salt inhibits the growth of spoilage organisms that may grow at later stages (Potter & Hotchkiss, 1998).

The main role of salt in fruit and vegetable fermentations is to promote the growth of lactic acid bacteria over spoilage bacteria and to inhibit enzymes that can cause softening (Nuraida, 2015; Paramithiotis, 2016).

Due to the essential function of salt in meat products to enhance flavour, texture and shelf-life, processed meat products comprise one of the major sources of salt. Research suggest that meat content has a strong effect on the perceived saltiness of food products (Desmond, 2006), and a study has shown that more salt is required in ground beef patties of high meat content to achieve the same perceived saltiness as low meat content beef patties (Ruusunen & Puolanne, 2005; Ruusunen *et al.*, 2005). In meat production, salt improves the binding of proteins in meat, and is also used in the curing process, to improve the tenderness by promoting the binding of water by protein (BMPA, 2010; Salt Institute, 2013).

4.2.1 Salt reduction and replacement products

The continuing pressure from government bodies, health professionals and trade partners on food manufacturers, to reduce the amount of salt in their products, has led to novel methods of salt reduction. Salt replacement usually involves the addition of other mineral salts, flavour enhancers, such as yeast extracts, monosodium glutamate (MSG) and hydrolysed vegetable protein (HVP), which can be used to improve the quality of reduced salt products (Keast, 2010; Rodrigues *et al.*, 2015).

The UK DoH announced the launch of the Public Health Responsibility Deal in 2011. As part of this responsibility deal, several pledges were made relating to food and public health, with salt reduction playing a major role. Pledge F2. Salt Reduction, outlined the salt reduction target of a further 15%, representing a reduction of 1g per person per day compared to salt consumption levels in 2007 (DoH, 2011). As a result of which, the levels of salt in many food products reduced significantly (some by up to 40 - 50%) as a result of previous targets (FSA, 2014b). The UK DoH is now taking further action across the whole food industry to further reduce consumer salt intake by continuing to review and lower salt levels in food. Targets have been set for 76 food product categories that are the greatest contributors of salt to consumer diets, by the end of 2017. It is reported that the target levels for some categories are ambitious, for which technical solutions will be necessary. New targets for 2017 include reduced levels for stocks and gravy (DoH, 2014b).

However, with regards to salt reduction, the Food and Drink Federation (FDF) which is working alongside the DoH to enable its members to achieve salt reduction targets, suggests that changes in salt content can only be made gradually to ensure that food products remain acceptable for consumers. The FDF states “Reformulation of products must be technically feasible and safe, and their taste must remain acceptable to consumers.” (FDF, 2015).

As part of an FSA review of salt commitments (FSA, 2010a), it is indicated that:

- members of the Association of Cereal Food Manufacturers have achieved a 49% reduction in the salt levels of branded breakfast cereals since 1998;
- the Biscuit, Cake, Chocolate and Confectionery sector group have achieved salt reductions of between 16% and 50%;
- the savoury snack food industry reduced the salt levels in its products by more than 25%; and
- major retailers including; Marks & Spencer, Morrison’s, Sainsbury’s, Waitrose, Asda, Co-operative and Tesco are compliant with 80-100% of the original Food Standards Agency 2010 salt target categories.

Salt substitutes consisting of other mineral salts can replicate a salty flavour. Potassium Chloride is the most commonly used substitute as typically, people consume less potassium than sodium despite the recommended daily allowance of potassium being higher than that of sodium (Caggiula *et al.*, 1985; WHO, 2012a, 2012b). Whilst other alternative mineral salts exist, they often deliver undesired flavours and therefore, are less commonly used. However, the use of potassium chloride is limited as typically, potassium chloride can only substitute up to 40% of sodium chloride without adverse effects on sensory properties (Choi *et al.*, 2014; Wu *et al.*, 2014). However, potassium and other salt substitutes may also cause hyperkalaemia in patients with renal conditions, which also limits its use (Doorenbos & Vermeij, 2003).

It is suggested that the use of technology to restructure salt crystals would be advantageous in salt-reduction efforts as salt levels will be reduced without having an impact on labelling (Wilson *et al.*, 2012).

With regards to safety and stability of reformulated food products, there is a lack of clarity regarding the need to conduct shelf life testing. It is suggested that industry-

wide guidelines regarding shelf-life and food safety, in relation to reformulation, is required (Wilson *et al.*, 2012).

The decline in dietary salt intake in the UK was entirely attributable to product reformulation (Griffith *et al.*, 2014). Sectors of the food industry have claimed that a lack of progress in salt reduction is down to technical feasibility and consumer taste acceptance of lower-salt food products (He *et al.*, 2014).

To enable salt reduction in food products, Cargill have created a 10 step guide (Cargill, 2009). However, these principles can also be applied to the reformulation of any nutrient in a food product. They include:

1. Identification of goals – is the business reformulating to make the product healthier, to meet government requirements and will the product meet consumer demand;
2. Know the competitive landscape – understand competitor products;
3. Understand the sources of the target nutrient – foods that naturally contain the target nutrient need to be factored into plans;
4. Set targets for reduction – realistic reductions that don't significantly compromise quality or desirable attributes;
5. Assess reduction options – reduce amount added, change proportions, replace with substitute or alternative;
6. Evaluate pros and cons – will it affect consumer purchase, consider cost versus benefits;
7. Product testing – test consumer reaction, shelf life and sensory analysis;
8. Determine product introduction – reformulated product can be introduced as a new product, reintroduced or introduced covertly;
9. Evaluation – assess process and purchase behaviour; and
10. Modify – monitor consumer opinion.

An in-depth review of the potential food safety impact of salt reduction initiatives identified gaps in research and knowledge, although predictive microbiology databases indicate efficacy of salt reduction and food safety. There is a need for challenge testing to be conducted as the intrinsic parameters of food products may have an impact on the behaviour of salt or pathogens. However, challenge testing can be very costly to conduct, particularly for SMEs. Furthermore, information regarding

salt reduction can be highly scientific and not presented in a manner that is accessible, understandable or applicable for SMEs (Christopher & Wallace, 2014).

4.2.2 Industry salt reduction efforts

Case studies with Welsh food and drink processing and manufacturing businesses identified that the reformulation of food products, to use salt alternatives, is a costly method (see Figure 9). It was identified that the sensory attributes of the reformulated food products are critical to ensure consumer acceptance at product re-launch. However, the process of conducting post-reformulation sensory analysis is often done in house and not with a consumer panel. Such analysis should be conducted objectively with a select panel and with consumer group to assess acceptability.



During 2015, the Process Development Technologist completed a reformulation project which aimed to reduce the salt content in pie and pasty fillings. Sensory analysis data provided the business with essential insight about consumer preferences, and highlighted feedback which suggested some products were too salty. This feedback resulted in the reformulation project which focussed specifically on reducing 'added salt' to pasty and pie fillings.

Development work identified that existing filling ingredients (in particular, bouillon) provided sufficient salt flavour to eliminate the need to add further salt as a standalone ingredient.

In some cases, this recipe reformulation, resulted in a reduced overall salt content of the finished product of more than 50%. Sensory feedback, conducted onsite with staff members was successful. The reformulated recipes within the study now replace the existing recipes.

As part of the project to reduce salt content, the Process Development Technologist also trialled the use of 'salt replacements' in the recipe. It was noted that the high cost of 'salt replacements' made reformulation using this method not feasible.

Figure 9: Salt reduction case study from Lewis Pie & Pasty Company, a Welsh bakery producing a wide range of pies and pastries.

Indeed the time and cost of reformulation was discussed and it was established that retail salt reduction pledges were drivers for reformulation. However, differences within the foodservice sector were determined. Furthermore, complications regarding the guidelines were also discussed (see Figure 10).

A Welsh manufacturer of ready meals has redeveloped a number of product lines within the last five years. The main driver for reformulation was attributed to retailer pressure. As response to the DoH salt reduction programme, Tesco have worked closely with their supply base to communicate salt targets and reformulate particular products to meet the

expected targets. As part of their continued supply into Tesco, the manufacturer was required to review (and where required), reformulate a number of their 'meat in sauce' products. This included the review of Chilli Con Carne, Chicken Tikka, Sweet & Sour Chicken, Sausage & Onion Gravy, Faggots & Gravy and Chicken Korma. The reformulation project for Tesco was predominately aimed at reducing salt levels in products, however at the same time, the manufacturer also took the opportunity to look at ways to reduce fat content (e.g. reducing 'added oil' in sauces). Reformulation (in particular reduced salt levels) had no noted effect on product shelf life (product was sold frozen). However, the reformulation resulted in considerable development costs due to the large number of products reviewed. The manufacturer successfully reformulated a number of product lines with reduced salt / reduced fat content. All reformulated recipes are still in use today.

One noted complication of reformulation was the inconsistency within the guidelines themselves. For example, it was noted that individual components of a typical ready meal may have been within the acceptable salt targets (e.g. the sausage and the gravy component). However, when the components were combined to make the finished ready meal, the overall product then fell outside the acceptable limits. This was both confusing for the development team and inevitability led to increased development costs and time. There is a marked difference in nutritional emphasis, depending on the customer. For example, supply into retail sector typically requires commitment from the food manufacturer to adhere to retailer salt reduction pledges. However, there is no such expectation for supply into the foodservice sector. From experience, food service put greater pressure on their suppliers in terms of product flavour and authenticity.

To ensure the manufacturer satisfies both the needs of the retailer and foodservice customers, their business has had to create two versions of each product line. The impact of this has led to; additional raw materials, and space to hold two product lines, reduced efficiency (greater number of product change overs) and additional technical resource to manage a higher number of products (in terms of specifications and HACCP plans).

Figure 10: Salt reduction case study from a Welsh ready meal manufacturer with over 100 products supplying catering, retail and foodservice markets.

Difficulties in achieving new salt reduction guidelines are discussed by an Independent Product Innovation Specialist on salt reduction in seasoning for meat products (Figure 11). As with other reformulation projects, time taken to reformulate was discussed and resulted in an increased production cost.

A dry ingredients manufacturer needed to reduce the salt content in its branded seasoning range of over 100 products to align with the requirements of the salt reduction guidelines of 2012. However, the targets were not met as they were cost inhibiting. Therefore, the company decided to launch products which met the 2010 guidelines as any further changes would make the product non-viable, commercially.

Typically the reformulation of each seasoning took approximately one month, with a reduction in salt leading to an increase in other components within the recipe. This led to an overall product cost increase of up to 8%. The company recovered the cost over time and did not pass this increase onto the final consumer. The changes were not detected by the final consumer organoleptically so it had no impact on sales or turnover and did not adversely affect the brand. The changes did not impact food safety, labelling or product yield and had a positive effect on improved meat texture. The company have chosen not to undertake further reformulation of their market leading product range at this stage as work on the products would be very costly and further reformulation activity is limited by legislative requirements, brand standards and cost.

Figure 11: Salt reduction case study from Claire Talbot, Independent Product Innovation Specialist on salt reduction in seasoning for meat products

Two of the far-reaching restrictions of product reformulation include cost and functionality. With the cost of certain raw materials being so low (i.e. salt), it is very difficult to find comparably priced or cheaper alternatives. Food is a highly cost-competitive market with manufacturers constantly challenged to keep food prices down and remain commercially viable. Adding cost to products via reformulation may not be a commercially viable option as the cost is largely absorbed by the manufacturer not the retailer or end customer. Secondly, regarding functionality, the use of salt, sugar and fats in food products has long been established to have preservation effects on foods. Altering the chemistry of foods by changing or reducing these ingredients, can often have a detrimental effect on the foods microbiological stability and ultimate food safety. This is of primary concern to any food producer. As discussed in Figure 12, reformulation to meet salt reduction aims is the most challenging to the food industry.

As a business, reformulation opportunities are something we continually look at. Salt is still the industry's biggest challenge – "the holy grail" to achieve salt reduction without adding cost. Also considered in the future plans for this business is Gluten Free development. In order to aid reformulation within the food industry there needs to be co-operation between the brand owner and retailers. The food industry needs to work together with an open, innovative approach and the shortage of skills in this area needs to be addressed.

Figure 12: Salt reduction case study from Claire Talbot, Independent Product Innovation Specialist on salt reduction in dairy based sauces

The importance of salt in meat production was also discussed by Charcutier Ltd, who identified areas that would benefit and support Welsh Food business with reformulation and development of their products. These included access to information and funding opportunities to enable reformulation (Figure 13).



Charcutier Ltd, established in 2011, is a small artisan charcuterie company based in West Wales. The business, which continues to grow in size and product range, brings together British, South European and North American methods of curing to create premium-quality meat products from its purpose built food manufacturing facility. The business currently sells a range of hand-salted bacons, air-dried meat products, and chilled gluten-free and preservative-free sausages across South Wales through direct deliveries and produce/farmers markets. Products are manufactured and sold both under

Charcutiers' own brand and also produced under customer and independent retailer own label. The business has also established a loyal customer base with popular restaurants and catering customers across Wales.

The company has not undertaken any product "reformulation" to date. However, much research has been completed to look at alternative ingredients to salt, which is commonly used within the production process of the product range manufactured by the business. There are plans in place to further investigate and trial development of products using salt replacement ingredients such as Sodium Nitrites and Nitrates or Potassium salts.

Given that salt has been used as a preservative in air-dried meat products for centuries and is a proven application for extending the product shelf-life on such products. The company recognises that one of the challenges with looking at the salt replacement ingredients is that there would be a significant cost and time lag to validating the safety of the products after such recipe changes throughout the product shelf-life. Full product testing would be needed to prove product safety and provide evidence to the Local Environmental Health Officers or Food Safety Auditors who could inspect the business's food safety practices at any time.

Salt is also a relatively cost-stable ingredient. Being widely available, its value as a commodity is low. An increase in ingredient cost would be anticipated with the use of salt replacement ingredients.

Maintaining flavour and sensory quality is also a challenge in reformulation of meat products such as those produced by Charcutier Ltd. Fat is important for mouth-feel and delivery of flavour, alongside salt as a preservative and flavour enhancer. Where these ingredients are reduced or removed, the sensory attributes of the product could potentially be negatively affected.

In terms of what drives the business to create new products or consider reformulation of recipes, our focus remains on quality, natural ingredients that make the best use of what is available in terms of local supply, seasonal products, reared and cared for from gate to plate. The business is focused on creating longevity in its supply chain, encouraging consumers to "eat well and live longer".

In order to support Welsh Food business with reformulation and development of their products, the business identified some key areas which would benefit all food businesses alike.

- 1. Access to "up-to-date" and reputable research information such as research papers and articles across all food categories. Whilst information is available currently via online subscription and services, there is often a costly subscription charge, which for many artisan and smaller producers makes accessibility unfeasible. The reliability of some of the free information tends to be biased or sales-driven, rather than academic or purely knowledge based.**
- 2. More information on available ingredients and how to access them would be advantageous. A central database or information pool of raw material suppliers and their contact details could aid the development process.**
- 3. Education for the authorities and industry on new food technologies/food safety developments. Development of fact sheets outlining key safety features associated with the product categories.**
- 4. Funding opportunities to support the development process and its cost may encourage smaller businesses to invest in reformulation or further product development.**

Figure 13: Salt reduction case study from Charcutier Ltd

Recommendation: Provide an easily accessible and affordable support framework for companies who are reformulating products to make them healthier.

4.3 The role of sugar in food production

Although sugar is naturally occurring in fruits, vegetables, dairy products and cereals, the most commonly used sugar is the disaccharide, sucrose, which is extracted from sugar cane and sugar beet to produce white sugar and molasses. Sucrose has many technological applications in the food industry and in the consumer kitchen (European Food Information Council, 2013).

Various forms of sugar, white or brown, powdered or syrup are used to increase the palatability of food products by giving food sweetness. This can be to balance bitter, sour, salty or sharp flavours such as in sauces (European Food Information Council, 2013).

When sugar is heated gently, a yellow-brown colour develops, which is referred to as the Maillard reaction. The Maillard reaction also has an effect on flavour and aroma of food products (Fayle *et al.*, 2002). Furthermore, it is suggested that the Maillard reaction can affect the texture of food products, which is due to the cross-linking of proteins (Yasir *et al.*, 2007).

Sugar is essential for defining the bulk of food products, such as the volume of cakes and biscuits. In baking, sugar absorbs water and slows the development of gluten. Sugar also gives baked products a tender crumb texture. Sugar is also used to stabilise egg foams, such as in the production of meringues (European Food Information Council, 2013; The Sugar Association, n.d.). Sucrose is essential for forming the structure of products such as cake, by regulating the gelatinisation of starch, which aids the incorporation of air and acts as an anti-staling agent (Cauvain & Young, 2008). Sucrose stearate, consisting of sugar and stearic acid, is utilised to retard the staling of baked products and soften the crumb (Bender, 2009).

Ice cream production uses sugar depression of the freezing point and for the creation of desirable properties. Sugar creates small ice crystals and affects the hardness and melting rate of ice cream (Muse & Hartel, 2004). Glycerine (sugar alcohol) is used as a humectant (to prevent loss of moisture) in bakery goods due to its ability to absorb a great quantity of moisture from the surrounding environment. This gives the crumb of baked goods a soft-eating character (Cauvain & Young, 2008).

With regards to food safety, sugar is commonly used for extending shelf-life of foods in food products such as jams and preserves as sugar has antimicrobial properties due to its ability to alter water activity in which, an increased concentration of sucrose lowers the available moisture required for microbial growth and survival (Marshall & Bullerman, 1994). Sucrose prevents the growth of bacteria in concentrations of 40-50% and the growth of yeasts and moulds at concentrations of 60% (Robinson, 2001).

4.3.1 Sugar reduction and replacement products

Various methods can be utilised to reduce the energy density (calories per gram) of food products by decreasing sugar. This can be achieved through removal, replacements, reduction and reduced portion sizes (European Food Information Council, 2013).

Even large reductions in sugar may not result in significant calorie reduction and can, in certain instances, result in increased calories, which could mislead consumers. Of greatest concern is the potential for the replacement of sugar to compromise food safety.

Removal of sugar from drinks is believed to be one of the most effective reformulation strategies to combat obesity (Temme *et al.*, 2011). Although sugar could be removed from some food products, this can have an impact on the sensory characteristics, the texture and appearance, and may reduce the shelf life of the food product.

There is no universal sugar replacer and each product provides challenges if sugar is replaced and/or reduced. The main issues are multiple ingredients and typically multiple additives to replace the many functions of sugar. This results in increased labelling and specific warnings about over consumption of certain ingredients (Cooper, 2012).

Sorbitol can be used in place of glycerine as a humectant in baked goods. However, weight for weight, glycerine is twice as effective and is cheaper than sorbitol. Furthermore, sorbitol usage levels are restricted due to its laxative effects (Cauvain & Young, 2008).

Although Mitchell (2008) discusses in the context of replacing sugar with sweeteners, that the utilisation of alternative food ingredients in food products to improve the nutritional status is reported to be a major driver of new product development within

the food industry, this can also be a driver in the case of salt or fat. Indeed, the food industry requires expertise to enable food and drink manufacturing and processing businesses to produce food products that taste similar to sugar-based products, but also offer consumer benefits including calorie reduction, dental health benefits, digestive health benefits and improvements in long-term disease (Mitchell, 2008).

The sugar substitutes market, is reportedly driven by the rising demand for sugar substitute products, such as high-intensity sweeteners, low-intensity sweeteners and high-fructose syrup. Leading companies, traditionally associated with sugar, such as Tate & Lyle PLC have made significant investments in advancement of technologies and new product development to provide superior quality, innovative and cost-effective sugar substitutes to customers (Research and Markets, 2015). It is reported that the value of the low-intensity sweeteners market is projected to reach US\$1.55 billion by 2020, with Xylitol accounting for the largest market share in 2014. It is suggested that beverages form the major application share of the use of sweeteners (Research and Markets, 2016).

Recommendation: Explore the potential to strengthen the links between leading edge scientific research (e.g. in the fields of nutrition, biochemistry and food technology) and businesses in order to enable Welsh businesses to commercialise and be first to market with innovative healthier products.

4.3.2 Industry sugar reduction efforts

The cost of reformulation, the purchase of alternatives and the advantages of reformulation, having included an increased yield are discussed by Fruitapeel Ltd (Figure 14). Consumer demand was identified as a driver for reformulation to reduce sugar. The timeline for reformulation is anticipated to be around 12 months. The cost of reformulation was determined to be costly due to sugar alternatives costing more than sugar, and consumer perceptions of sweeteners was determined to be a potential barrier to reformulation.



Established in 2006, Fruitapeel Ltd is one of the fastest growing confectionary sauce, smoothie and fruit juice producers in the UK. Operations from the South Wales site see the manufacture and packing of an expanse of product lines both under retail own label for many of the major multiples, as well as established category brands and the production of

Fruitapeel's own brand products including Fun Juice and Freau. Products are packed into multiple formats to cater for the retail take home and impulse markets, as well as food service and further business to business customers.

Fruitapeel are clear drivers in their category within the drinks sector, and future proofing the product portfolio against arising sector trends has led to the interest in researching and embarking upon the reformulation of selected juice drink products. As a result of customer demands, and focus within the sector arising from the "bad press" surrounding sugar content in smoothies and fruit juice, the business began reformulation work looking to reduce sugar levels in line with NHS targets and customer brand standards.

Currently the business is working on two high-profile reformulation projects looking at reducing sugar content. The sugar reduction trend has fairly recently fallen under the spotlight of the drinks industry where it had previously been heavily focussed on food products. Whilst still in the early stages of development for the new reformulation work, being around two months into what can typically be a 12 month development timeline, the feedback to date has been positive and looking to be a successful reformulation to the recipe. It is thought that "the untrained taster would not know that it (the new recipe) did not have the sugar in it". However, feedback following the launch will give more information. Store trials on the current reformulation project have been undertaken which have given successful results in positive consumer feedback.

To date, the business has focussed reformulation primarily on juice drinks to date. One successful product on the market can be seen with the Tesco 30% Reduced Sugar Orange Juice Drink which has used sugar replacement ingredients (Stevia) to maintain the products flavour profile, following recipe adjustments removing some of the natural juice content and replacing it with water.

Around 5-6 products have been looked at for reformulation to date, however, customers are now setting lower sugar content and calorie intakes as a base line in the product development briefs set, so it's not so much a case of reformulating existing recipes to reduce sugar or calories, but more towards looking at new recipes with intrinsically lower calories or without added sugar to begin with. Nutrition targets are typically set by the retail customer but these are aimed towards the wider targets, set for example by the NHS, which requires a reduction of 30% sugar in the recipe compared to the standard recipe, in order to meet the requirements of "reduced sugar" claims.

General category sales have not been seen to fluctuate that much as a result of the reformulated products. Consumers tend to buy the product because they enjoy it and it tastes nice and not necessarily because its sugar is reduced.

In relation to cost of reformulation, whilst some of the sugar replacement ingredients are more expensive when compared gram for gram, the application rates are significantly lower to achieve the same levels of sweetness and therefore, the cost differential has balanced out.

One of the projects being worked on at the moment is reduced sugar content by 65% by replacing sucrose with fructose, which is said to be 70% sweeter in terms of flavour profile, and by using stevia as well as combined replacements at a lower addition rate, we were able to maintain the flavour during the overall recipe reformulation.

One of the challenges of reformulating recipes, especially if through dilution with added water, is to maintain the flavour of the product, as well as being mindful of food safety parameters such as pH levels which contribute to the product safety over its shelf-life.

However, one of the advantages, is that in some recipes, yields have increased as a result of reformulation, where more bottles per batch are packed as the density of the recipe

has decreased. The Specific Gravity of the blend is used to convert the batch weight in grams to the legally declared volume in millilitres, as displayed on the pack label.

Typically for the business, the drivers behind reformulation and new product development are our customers who are acting on market trends and consumer buying behaviours. Media also has an influence on consumer perception and attitudes towards the foods we buy and what we eat. Consumer perceptions however can also lead to barriers for reformulation. For example, “Sweeteners tend to be artificial and the customers don’t want them in their products”. The customer wants “natural”, healthy products but often without the natural nutritional profile that is intrinsic to the product.

In terms of what would make reformulation or product development easier for the business, and in general, a wider availability or knowledge of information on application rates for “alternative ingredients”. Sometimes a lot of trial and error goes into reformulation, which is lengthy and costly in terms of resource time. Also, as little is known about the long-term effects of some of these sugar replacement ingredients in relation to health, it is important that the information that is available is shared, not only in industry but largely with the consumer so that they can make an informed decision on what they buy and consume. Consumer awareness and the correct marketing of reformulated products is important.

Figure 14: Sugar reduction case study from Fruitapeel Ltd

Similarly, Liz Tucker (Figure 15) described that the cost of range re-design to a snack manufacturer to reformulate was high and consequently, further reformulation of the products at this stage was not viable.



I have recently worked with a snack bar manufacturer to reduce sugar and increase fibre content in their products. The branded product was already established in the ‘sports market’ but in order to gain further market share, the company recognised they needed to reformulate the product to reduce its calorific content and realign its ‘nutrition credentials’ with a broader demographic.

The reformulation project took 6 months to get 12 products to market (some of them new). The new range was designed to maintain the critical product characteristics and taste, achieving nine months shelf life (ambient stable), retail selling price and no changes to the manufacturing process. This was achieved by changing ingredients, and carefully selecting and replacing costly raw materials.

The new product range was designed and the company was able to consider a new claim for their products ‘high in unsaturated fats’. The reformulated product range was launched and is successfully established in the retail market. The company will not consider any further reformulation of the products at this stage as the cost to redesign the range has been high. The company will monitor the commercial success of the changes and consider a further reformulation cycle in 12 – 15 months based on their findings.

Figure 15: Sugar reduction case study from Liz Tucker, Registered Nutritionist/Food Industry Consultant at Selectfood

4.4 Reformulation

Although many food products that have been reformulated have been introduced on the European market, the trend is expected to continue, although, it is suggested that consumer acceptance, safety aspects, technological challenges and food legislation can limit the feasibility of reformulation of many foods (van Raaij *et al.*, 2009). However, the potential impact of reformulated foods on health needs to be considered through regular food consumption surveys (van Raaij *et al.*, 2009).

The FDF indicate that there is a reduced incentive for reformulation in manufacturing, due to the EU Nutrition and Health Claims Regulation (EC) No. 1924/2006, which restricts on-pack health claims. It is suggested that a temporary reformulation claim e.g. “10% less saturated fat”, not linked to a nutrient profile, would provide an incentive for the food industry to reformulate, such actions would also enable consumers to make healthier choices (FDF, 2009).

The costs involved with reformulation may influence the decision of a food and drink manufacturing and processing business to reformulate. Associated costs may include research and development, the implementation of new recipes and sourcing of new ingredients, packaging, and changes in process approach or technical equipment. The FDF also indicate that there can be significant costs associated with reduction in portion sizes (FDF, 2009).

Given that many food and drink manufacturing and processing businesses in Wales are micro and small and medium enterprises (SME)s investment in reformulation may be more financially challenging than for larger companies. It is suggested that reformulation alone is unlikely to provide a complete solution to the challenge of improving eating patterns and nutrient provision to consumers in the UK. However, it is a contributor (Buttriss, 2013).

4.4.1 Drivers for reformulation

As indicated in the case study by Baraka Foods (Figure 16), reformulation is not always conducted to reduce the contents of fat, salt and sugar. Drivers for reformulation also include a reduction in manufacturing costs. Liz Tucker described how ‘start-up’ companies that have designed ‘healthier’ and ‘more natural’ innovative

products, in-line with consumer demands have acted as a driver for larger companies to reformulate (Figure 17).



Baraka Foods Ltd manufacture chilled and frozen products for foodservice.

The last major reformulation project (completed Summer, 2015) focused on the development of BBQ ribs (a product which represents approximately 1% of overall product sales). The reformulation brief was aimed specifically at reviewing the existing rib size, and looking at the meat to sauce ratio. The business was also particularly interested in reducing the overall manufacturing cost of the product, and to reduce overall product waste. Although the reformulation brief was not specifically designed to reduce/remove fat/salt/sugar, by its nature, reformulation of this product did have an impact on fat/salt/sugar content.

The reformulation exercise resulted in Baraka foods Ltd being successfully able to reduce the rib size and increase the sauce percentage. The reformulated recipe is still in use today, with no further development required. Reformulation of the BBQ ribs did not have a detrimental impact on product shelf life or sensory attributes of the product. However, reformulation did result in a recipe change, which ultimately resulted in the need to review and update finish product labels.

Baraka Foods identify that reformulation is typically customer driven. However, as was the case with the BBQ ribs, some reformulation activity is driven from within the business in an attempt to reduce manufacturing costs. Baraka Foods are aware of the careful balance needed to meet customer expectations and ensure business efficiency. As an example, the business have a number of different recipe variations for the same product (including BBQ sauce), which have arisen due to customer need. The business is aware of the potential inefficiencies of multiple recipes, however, also understand that to streamline existing recipes into one product would take up a large amount of technical resource and time.

Although the business can see the benefits of reformulation, the costs, in terms of technical expertise and time associated with development (update recipes, labels, production paperwork etc.), is noted to be the biggest barrier to reformulation.

The business does not currently have any priorities with regards to fat/salt/sugar reduction. All product manufactured by the business is supplied into food service and therefore, reformulation on this basis is not currently on the customer radar. In terms of future plans for reformulation, the business is looking at reformulation in an attempt to reduce the total number of allergens handled by the business.

Figure 16: Reformulation case study by Baraka Foods Ltd

Cumulatively, from the case studies presented, drivers for reformulation have been identified and include consumer demand for 'healthier' food products, and in the case of salt, reduction pledges.

4.4.2 Barriers to reformulation

Although many of the case studies have identified barriers to reformulation, Figure 17 indicates the need for independent, qualified, technical resources to facilitate effective new product development and reformulation.



As a registered Nutritionist, I actively work with many companies to reformulate their products. For 15 years, I have been active in ‘food cleansing’; supporting companies to clean-up their products in line with brand standards and legislation. Ten years ago, the emphasis was on fat reduction. Now, the focus has shifted to sugar reduction.

A major driver for reformulation in the food sector, in the past five years, has been start-up businesses and entrepreneurs who have designed innovative products to be healthier and more natural, in line with consumer demand and nutritional balance. This has directly impacted on the larger companies who have responded to these market influences and are working to drive healthier products into the market place.

However, cost, technical knowledge & skills, facilities, timing, size of business and ‘taste’ are key barriers to product reformulation for the manufacturer. Many ‘start-ups’ and small businesses are ill-equipped and resourced to facilitate effective new product development so require access to an independent, qualified, technical resource to support this activity. The ‘nutrition credentials’ of a product are essential to identify a suitable market for the product and many businesses do not consider this aspect of the product design sufficiently to optimise and select the appropriate market place. If a company is to make a ‘nutrition / health claim’, it must be independently, scientifically and robustly documented and justified.

Innovation and new product development are critical elements to ensure healthier, nutritionally balanced products are manufactured for the consumer. The development of more affordable technical support, knowledge and skills is required by the industry, in order to progress the reformulation agenda.

Figure 17: Reformulation case study from Liz Tucker, Registered Nutritionist/Food Industry Consultant at Selectfood

The time-scale to plan and conduct reformulation was discussed by the majority of those that participated in case studies, indeed the time taken to reformulate a product, prior to reaching the marketplace can be a potential barrier to reformulating food products.

Changes in sensory attributes of food products, as a result of product reformulation and the acceptability of alternatives and additives to enable successful reformulation to reduce the content of the target nutrient, was identified by retailers, while brand restrictions regarding additives was also identified. Furthermore, the attitudes and perceptions of consumers regarding alternative ingredients and additives was discussed. It may be suggested that product sales may decrease as a result of product reformulation due to the addition of ingredients that are undesirable to consumers.

The expenditure of conducting reformulation trials was determined to be costly. Similarly, the cost to purchase suitable alternatives was often more costly than the product being reduced such as the case with salt. Increased production costs were

also identified as a result of reformulation. The cost of reformulation was identified to have an impact on the food producer and not retailers or the consumer.

Recommendation: Consider conducting research with Welsh companies to obtain an in-depth understanding of the barriers to re-formulating and producing healthier products.

The functionality of the nutrients in the food product was discussed in many of the case studies included in this report, removing and reducing a nutrient not only alters the chemistry of foods which can impact on stability, water activity can be altered which can have negative affect on food safety.

Recommendation: Consider developing extended shelf life technology and expertise to potentially off-set the reduction in shelf life due to fat, salt or sugar reduction.

4.4.3 Benefits of reformulation

Although the process of reformulation was deemed to be costly by many, cost savings from lower priced alternative raw materials and reduced wastage was indicated along with reduced costs of cooking and increased yield in some cases. Improvements in product quality and product stability were identified as a result of the addition of alternatives. Reformulation was identified to enable consumer choice and reformulated food products were often more desirable to certain consumer groups.

As consumers in the UK and globally are demanding healthier food products, there are significant commercial opportunities for Welsh food and drink manufacturing and processing companies to reformulate and develop new products to meet these changing demands.

Recommendation: Consider trade development activity to encourage companies supplying healthier products by supporting Welsh companies' presence at healthier food focussed trade shows and events (e.g. Food Matters Live).

Recommendation: Consider export opportunities of healthier food products to countries with a fast growing market for healthier products.

4.4.4 Support to enable reformulation

Several case studies identified potential areas of support to enable successful reformulation of food and drink products. Support was identified as a requirement to conduct sensory analysis to ensure product acceptability following reformulation (see Figure 13, Figure 14 & Figure 17).

The provision of relevant and accessible information, based on scientific research, to inform the food industry of developments within reformulation and availability of new alternative ingredients or techniques relating to product quality and safety, was identified.

Funding to enable reformulation and to support continued reductions of target nutrients was also suggested as potential support mechanisms to enable food and drink producers and manufacturers in Wales to reduce levels of fat, salt and sugar in products.

Recommendation: Consider the use of the Annual Industry Survey of Welsh Food and Drink Businesses to capture more data and insights into the development of healthier products by Welsh companies.

4.5 Responsibility Deal

In addition to the health at work and physical activity pledges, the UK Public Health Responsibility Deal includes alcohol and food pledges which focus on what actions food and drink manufacturers, retailers, caterers, suppliers and catering and hospitality outlets can do to impact consumer food choices in the UK, such as the inclusion of calories on menus, labelling alcohol units or reducing salt in food and takeaways. The goal is for companies to voluntarily work in partnership with the Government to create an environment that empowers and aids people to live more healthily (DoH, 2013b).

Although there was no pledge directly relating to sugar reduction in the Responsibility Deal, 'Pledge F4. Calorie Reduction', aims to enable consumers to consume fewer calories through food product reformulation and menu revisions, review of portion

sizes and shifting the market towards lower calorie options. With regards to reformulation, the aim is to decrease energy density with fat and sugar reduced in food products, or they are to be substituted with lower calorie alternative ingredients, such as sweetener in the case of sugar (DoH, 2015b).

The Food Network Team's calorie reduction development tool to enable adherence to the Responsibility Deal, indicates that there are a number of possible actions in response to the call for action on obesity. These include reformulation, portion size, development of lower calorie options, encouraging consumers to choose healthier options, satiety enhancers, balance of portfolio or menu and activities intended to inform and educate consumers towards making healthier choices (DoH, 2014a).

Research suggests that the Responsibility Deal approach is fundamentally flawed as it requires voluntary action from the food industry, in which food businesses need to prioritise public health benefits above benefits to the food business (Panjwani & Caraher, 2013).

A review of the Responsibility Deal by the London School of Hygiene and Tropical Medicine's Policy Innovation Research Unit (Knai *et al.*, 2015) concludes:

- If fully implemented, some of the interventions proposed by the Responsibility Deal can contribute to improving the English population's diet but the implementation is difficult to establish because the reporting process lacked consistency and metrics;
- Most interventions reported were clearly or possibly already underway prior to the Responsibility Deal; and
- Many of the interventions, most likely to be effective in improving diets are not consistently reflected in the Responsibility Deal pledges. These include "food pricing strategies, restrictions on marketing across the range of media and a specific focus on reducing sugar intake".

A review paper on obesity and industry self-regulation of food and beverage marketing, reported that the measurable effects of the self-regulations tend to be relatively small. It is suggested that further research is needed on such schemes if industry self-regulation of marketing behaviour is to become an effective and credible approach in combating obesity (Ronit & Jensen, 2014).

5. Discussion

The WHO Global Strategy on diet, physical activity and health suggests that local situations need to be considered prior to preparing national policies and national guidelines. Overweight and obesity should not be approached as individual problems, improvements in dietary behaviour is societal, it demands population-based multi-sectorial, multi-disciplinary and culturally relevant approach (WHO, 2004).

Health policy is supported by the concept that people should take responsibility for their own health, and policy-makers focus on motivating people to make healthier lifestyle choices. For the reduction of obesity, policy needs to give empowerment, choice and responsibility to consumers (Roos, 2012). Nutrition policy has shifted its focus during times of under-nutrition from food supply and ensuring sufficient food for the population to focusing on health and individual responsibility during a time of over-nutrition (Roos, 2012).

Although obesity is described as a chronic illness, it is a chronic illness that can be prevented. It is suggested that there needs to be clear distinctions between obesity treatment and obesity prevention (Kumanyika & Obarzanek, 2003). Behavioural treatment is an approach used to help individuals develop a set of skills to achieve a healthier weight. Behavioural change is more than helping people decide what to change; it enables people to identify how to change (Foster *et al.*, 2005). For the development of successful approaches for treating people that are obese and overweight, it is suggested that programmes should focus and target different cultural dimensions (Davis *et al.*, 1999).

Swedish research has determined that no statistically significant relationships existed between intake of total energy and obesity. However, irregular meal patterns (omitting breakfast/lunch) and larger self-reported portion sizes were determined to be related with obesity (Berg *et al.*, 2009). There is a need to educate consumers regarding the importance of regular meal patterns.

According to Knai *et al.* (2015), “irrespective of the nature of a public health policy to improve nutritional health, pledges or proposed actions need to be evidence based, well-defined, and measurable, pushing actors to go beyond “business as usual” and setting out clear penalties for not demonstrating progress”.

In addressing childhood obesity, the House of Commons Health Committee has demanded “bold and urgent” action from the UK Government (House of Commons Health Committee, 2015) and a similar approach is probably required in Wales to address the food, nutrition and health challenges facing the total population.

The Welsh food policies relating to health and nutrition are most likely to influence the food environment and the food system rather than behavioural change communication.

The potential objectives of the food policies relating to health and nutrition include:

- to contribute to an integrated food, diet and health policy framework for Wales;
- to invite all Welsh businesses involved in the food industry, from farm to table, to voluntarily play their part in helping the Welsh population to participate in a healthier lifestyle by making healthier food and drink options available, affordable, acceptable and accessible;
- to invite all food retail and food-service businesses operating in Wales to voluntarily play their part in helping the Welsh population to participate in a healthier lifestyle by making healthier food and drink options available, affordable, acceptable and accessible; and
- whether starting a food business, already manufacturing in Wales or elsewhere in the world, Wales will be the most supportive location to develop, manufacture and launch healthier food products.

The first three of the four pronged approach of communication, reformulation, and monitoring proposed by Cappuccio *et al.* (2011) is the most realistic in delivering the changes required, regulatory could be considered as a last resort.

6. Recommendations arising from the Food for the *Future* report

Following completion of this report, the recommendations to consider have been classified into the following categories:

- product reformulation;
- consumer research;
- research and development;
- trade channel engagement;
- trade development; and
- industry analysis.

6.1 Product reformulation

Recommendation 1: Provide an easily accessible and affordable support framework for companies who are reformulating products to make them healthier.

Developing healthier products is complex and requires some investment of resources. As a priority, it is recommended that a support framework is developed that help companies to develop new products or reformulate existing products that will offer consumers a healthier alternative. Ideally, the support would provide a mechanism to provide resource, expertise and funding to achieve the following:

- identify healthier alternative to existing products;
- develop new healthier products;
- fund sensory trials;
- shelf life testing;
- retrain staff to ensure technical expertise;
- work with supply chains to identify alternative raw materials;
- work with supply chains to identify a sustainable, commercial raw material alternative;
- work with process experts to define best practice in manufacturing to assure product safety and optimal shelf life; and
- work with knowledge experts to define innovation processes and new product development systems that comply with the legislative framework, technical, market and consumer demands.

Specific companies and categories that could be the focus for this support:

- companies in key categories that will deliver unique, healthier products that have potential UK and global sales potential (e.g. healthier versions of free-from products);
- companies would benefit from focussed support to develop healthier alternatives that may unlock UK and global sales opportunities;
- companies that are currently supplying products targeting children and/or supplying into trade channels that supply children (e.g. schools catering).

Recommendation 2: Consider developing specific initiatives to increase the number of and competitiveness of healthier products in selected categories.

Some categories within Wales are contributing a disproportionate amount of calories, sugar, salt and fat to the diet. Whilst not all products consumed in Wales are made in Wales, there will be benefits to both Welsh consumers and producers from initiatives to improve the health credentials in these categories:

- bakery, including biscuits, confectionery, cakes and pastries;
- meat pies and pastries;
- sausages and burgers;
- dairy products;
- red meat.

The initiatives will be voluntary and will focus on developing specific objectives, measures and actions that can be delivered by individual companies. The relevant trade body or organisation may be involved and potentially, a cluster approach could be adopted.

6.2 Consumer research

Recommendation 3: Consider commissioning consumer research to enable Welsh businesses to better understand Welsh and UK consumers' perceptions of healthier products and messaging.

Consumer research and insights that are shared with Welsh companies will provide these companies with an advantage in identifying potential opportunities and improving their marketing of healthier products. As well as the existing Kantar research, additional research themes could include:

- on-pack health claim messaging;
- appropriate portion sizes;
- there is a need to determine the acceptable size for smaller portions, the threshold at which consumers will consume two portions instead of one due to reduced size, thus increasing calorific intake; and
- importance of nutritional claims in food service channels.

Recommendation 4: Consider the feasibility of developing a research programme to develop an improved understanding of the in-store factors that influence consumer behaviours (e.g. packaging design, merchandising, location in-store, pricing, promotional space) in order to inform suppliers and retailers on how to increase sales of healthier products and categories.

Supermarkets and leading manufacturers have their own “mock shops” and virtual reality spaces to enable trials of merchandising and packaging. It would be a benefit to many Welsh food businesses and particularly those developing products with healthier credentials, to be able to access such facilities and the results from research programmes that these facilities provide. In addition, a better understanding of shopper behaviour may enable evidence-based policy to be introduced to encourage consumers to change behaviours (e.g. an understanding of the impact of end-aisle promotions on the purchase of less-healthy products).

6.3 Research and development

Recommendation 5: Consider developing extended shelf life technology and expertise to potentially off-set the reduction in shelf life due to fat, salt or sugar reduction.

Reducing fat, salt and sugar may increase a product’s health credentials but may also reduce shelf life. To off-set this potential problem, the development and provision of additional expertise in shelf-life extension would benefit Welsh companies.

Recommendation 6: Explore the possibility of establishing a world leading healthier product reformulation capability in Wales.

This initiative would potentially benefit existing Welsh companies but also attract new inward investment from global companies looking to benefit from the expertise available in Wales.

Recommendation 7: Explore the potential to strengthen the links between leading-edge scientific research (e.g. in the fields of nutrition, biochemistry and food technology) and businesses in order to enable Welsh businesses to commercialise and be first to market with innovative healthier products.

The majority of the significant health innovation in the food industry is likely to be driven by scientific discoveries that are then commercialised by businesses. Food Valley at the University of Wageningen in the Netherlands is a good example of a

successful infrastructure that has been developed to discover and exploit innovation in the food industry. Within Wales, there may be an opportunity to foster closer links between scientific and research organisations, which can work with industry to produce innovative, healthier products.

6.4 Trade channel engagement

Recommendation 8: Engage with trade channels (e.g. supermarkets, food-service and public procurement) to understand their priorities for encouraging their customers to have healthier lifestyles in order to develop joint initiatives for implementation in Wales.

The initiatives would have to be realistic and be accommodated by trade partners that may have to adapt their UK operations for Welsh-specific healthier initiatives. These could include:

- collaborative working to promote new public health messages;
- agreement to limit confectionery at checkouts;
- Welsh specific healthier eating recipe ideas;
- menus showing calories;
- joined up approach to include the current engagement with supermarkets about alcohol; and
- healthier product briefs to be developed by Welsh suppliers.

Recommendation 9: Consider the potential for partnership with business to increase fresh and/or frozen fruit and vegetable sales in convenience stores in catchments without easy access to supermarkets or independent fruit and vegetable retailers.

Buying affordable and appealing fresh fruit and vegetables in some locations is difficult because of the absence of multiple retailers and the operational challenges that selling this category presents to some independent retailers (e.g. high wastage). A review of the Change4Life Convenience Stores project will help to determine the potential effectiveness of this initiative.

6.5 Trade development

Recommendation 10: Consider trade development activity to encourage companies supplying healthier products by supporting Welsh companies' presence at healthier food focussed trade shows and events (e.g. Food Matters Live).

If feasible, there may also be benefit in providing more favourable terms and support for companies promoting healthier products at trade shows (e.g. IFE).

Recommendation 11: Consider export opportunities of healthier food products to countries with a fast growing market for healthier products.

The development of export trade activity to encourage companies supplying healthier products to consider export opportunities to countries with a fast-growing market for healthier products (e.g. UAE, Kuwait) may act as a catalyst to encourage continued reformulation.

6.6 Industry analysis

Recommendation 12: Consider conducting research with Welsh companies to obtain an in-depth understanding of the barriers to re-formulating and producing healthier products.

A research project to understand companies' perceptions of the potential barriers to reformulation will inform future initiatives to support companies planning to reformulate or develop healthier products.

Recommendation 13: Consider reviewing the level of uptake by Welsh companies and assess compliance with the recommended format for front-of-pack nutritional labelling and consider supporting those companies not currently complying.

As part of this initiative, training and guidance on implementing the recommended format for front-of-pack nutritional labelling can be provided to those companies that have been identified as not complying.

Recommendation 14: Consider the use of the Annual Industry Survey of Welsh Food and Drink Businesses to capture more data and insights into the development of healthier products by Welsh companies.

The collection of this data will enable analysis, which can inform the future focus for interventions. For example, if the survey identifies a lack of healthier NPD in the dairy category, specific interventions could be developed to address this weakness.

7. References

- Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behaviour and Human Decision Processes*, 50, 179 - 211.
- Ajzen, I. & Fishbein, M. (1980). *Understanding Attitudes and Predicting Social Behavior*. Prentice-Hall.
- Albarracín, W., Sánchez, I.C., Grau, R. & Barat, J.M. (2011). Salt in Food Processing; Usage and Reduction: A Review. *International Journal of Food Science & Technology*, 46(7), 1329-1336.
- Allender, S. & Rayner, M. (2007). The Burden of Overweight and Obesity-Related Ill Health in the UK. *Obesity Reviews*, 8(5), 467-473.
- BDA. (2015a). Food Fact Sheet - Fats. The British Dietetic Association. Retrieved 1st December 2015, from <https://www.bda.uk.com/foodfacts/FatFacts.pdf>
- BDA. (2015b). Sugar and Children's Oral Health. Hot Topic - May 2015. British Dental Association. Retrieved 4th January 2016, from <https://www.bda.org/dentists/policy-campaigns/public-health-science/public-health/Documents/Hot%20Topic%20-%20Sugar%202015.pdf>
- Bell, J., Mora, G., Hagan, E., Rubin, V. & Karpyn, A. (2013). Access to Healthy Food and Why It Matters: A Review of the Research. The Food Trust & Policylink. Retrieved 12th January 2016, from https://www.policylink.org/sites/default/files/GROCERYGAP_FINAL_NOV2013.pdf
- Bender, D.A. (2009). *A Dictionary of Food and Nutrition*: OUP Oxford.
- Berg, C., Lappas, G., Wolk, A., Strandhagen, E., Torén, K., Rosengren, A., Thelle, D. & Lissner, L. (2009). Eating Patterns and Portion Size Associated with Obesity in a Swedish Population. *Appetite*, 52(1), 21-26.
- BHF. (2015). Cardiovascular Disease Statistics 2015. Book 146. Published: 08/12/2015. Retrieved 10th December 2015, from <https://www.bhf.org.uk/publications/statistics/cvd-stats-2015>
- BMPA. (2010). Guidance on Salt Reduction in Meat Products for Smaller Businesses. British Meat Processors Association. Retrieved 13th December 2016, from http://www.bmpa.uk.com/attachments/Resources/2665_S4.pdf
- BNF. (2015). The Scientific Advisory Committee on Nutrition's Recommendations on Sugars. British Nutrition Foundation Factsheet. from <https://www.nutrition.org.uk/attachments/article/872/sugars%20factsheet.pdf>
- Bosman, M.J.C., Vorster, H.H., Drewnowski, A., Steyn, H.S. & Schonfeldt, H.C. (1996). Characteristics of High-Fibre Muffins Containing Various Levels of Fat Substitute. *South African Journal of Food Science and Nutrition*, 8(2), 49-54.
- British Nutrition Foundation. (2013). Good Fats and Bad Fats Explained. Retrieved 1st December 2015, from <http://www.nutrition.org.uk/healthyliving/basics/fats.html>
- Bundesministerium Für Gesundheit. (2014). Austrian Salt Initiative.

- Buttriss, J.L. (2013). Food Reformulation: The Challenges to the Food Industry. *Proceedings of the Nutrition Society*, 72(01), 61-69.
- Caggiula, A.W., Wing, R.R., Nowalk, M.P., Milas, C., Lee, S. & Langford, H. (1985). The Measurement of Sodium and Potassium Intake. *The American Journal of Clinical Nutrition*, 391-398.
- Calle, E.E. & Kaaks, R. (2004). Overweight, Obesity and Cancer: Epidemiological Evidence and Proposed Mechanisms. *Nature Reviews Cancer*, 4, 579-591
- Calle, E.E. & Thun, M.J. (2004). Obesity and Cancer. *Oncogene*, 23(38), 6365-6378.
- Cappuccio, F.P., Capewell, S., Lincoln, P. & McPherson, K. (2011). Policy Options to Reduce Population Salt Intake. *BMJ*, 343.
- Cargill. (2009). 10-Step Guide to Lowering the Sodium in Food and Beverage Products. Salt-3296/01-09/500/Cls. from <http://www.cargill.com/salt/wcm/groups/public/@cseq/@salt/@assets/documents/document/na3019695.pdf>
- Cauvain, S.P. & Young, L.S. (2008). Strategies for Extending Bakery Product Shelf-Life *Bakery Food Manufacture and Quality*. Wiley.
- Centre for Science in the Public Interest. (2015). International Action on Sodium. Retrieved 15th January 2016, from <http://cspinet.org/new/pdf/cspi-2015-international-action-on-sodium-fact-sheet.pdf>
- Choi, Y.M., Jung, K.C., Jo, H.M., Nam, K.W., Choe, J.H., Rhee, M.S. & Kim, B.C. (2014). Combined Effects of Potassium Lactate and Calcium Ascorbate as Sodium Chloride Substitutes on the Physicochemical and Sensory Characteristics of Low-Sodium Frankfurter Sausage. *Meat Science*, 96(1), 21-25.
- Christopher, D. & Wallace, C.A. (2014). The Food Safety Impact of Salt and Sodium Reduction Initiatives. *Perspectives in Public Health*, 134(4), 216-224.
- Cobiac, L.J., Vos, T. & Veerman, J.L. (2010). Cost-Effectiveness of Interventions to Reduce Dietary Salt Intake. *Heart*, 96(23), 1920-1925.
- Collins, M., Mason, H., O'Flaherty, M., Guzman-Castillo, M., Critchley, J. & Capewell, S. (2014). An Economic Evaluation of Salt Reduction Policies to Reduce Coronary Heart Disease in England: A Policy Modeling Study. *Value in Health*, 1(5), 517 - 524.
- Cooper, J.M. (2012). Product Reformulation: Can Sugar Be Replaced in Foods? *International Sugar Journal*, 114(1365), 642-645.
- Cross-Government Obesity Unit for England. (2009). Healthy Weight, Healthy Lives: One Year On. Retrieved 8th February 2016, from http://webarchive.nationalarchives.gov.uk/20100407220245/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_097623.pdf
- Dahl, L.K. (1972). Salt and Hypertension. *The American Journal of Clinical Nutrition*, 25(2), 231-244.
- Davis, N.L., Clance, P.R. & Gailis, A.T. (1999). Treatment Approaches for Obese and Overweight African American Women: A Consideration of Cultural

- Dimensions. *Psychotherapy: Theory, Research, Practice, Training*, 36(1), 27-35.
- de Lorgeril, M., Salen, P., Martin, J.-L., Monjaud, I., Delaye, J. & Mamelle, N. (1999). Mediterranean Diet, Traditional Risk Factors, and the Rate of Cardiovascular Complications after Myocardial Infarction: Final Report of the Lyon Diet Heart Study. *Circulation*, 99(6), 779-785.
- DEFRA. (2014). Family Food 2013. Retrieved 10th December 2015, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/385694/familyfood-2013report-11dec14.pdf
- DEFRA. (2015). Family Food 2014. Department for Environment, Food and Rural Affairs. Retrieved 17th December 2015, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/485982/familyfood-2014report-17dec15.pdf
- Desmond, E. (2006). Reducing Salt: A Challenge for the Meat Industry. *Meat Science*, 74, 188-196.
- Diabetes UK. (2015). State of the Nation: Challenges for 2015 and Beyond. Wales. Retrieved 26th November 2015, from <https://www.diabetes.org.uk/Upload/Wales/Website%20NEW/Diabetes%20In%20Wales/State%20of%20the%20Nation%20WALES%202015.pdf>
- DoH. (2011). The Public Health Responsibility Deal. Department of Health. March 2011. Retrieved 16th December 2015, from <https://responsibilitydeal.dh.gov.uk/wp-content/uploads/2012/03/The-Public-Health-Responsibility-Deal-March-20111.pdf>
- DoH. (2013a). Guide to Creating a Front of Pack (Fop) Nutrition Label for Pre-Packed Products Sold through Retail Outlets. Retrieved 2nd December 2015, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300886/2902158_FoP_Nutrition_2014.pdf
- DoH. (2013b). Public Health Responsibility Deal. Retrieved 2nd December 2015, from <https://responsibilitydeal.dh.gov.uk/wp-content/uploads/2013/02/Generic-RD-Flyer-Final.pdf>
- DoH. (2013c). Technical Guidance on Nutrition Labelling. Obesity and Food Policy Branch. Health and Wellbeing Division. Department of Health. Retrieved 10th January 2016, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/207842/2013-06-19_Nutrition_Technical_Guidance.pdf
- DoH. (2014a). Calorie Reduction Pledge Development Tool. Public Health Responsibility Deal – Food Network. from <https://responsibilitydeal.dh.gov.uk/wp-content/uploads/2014/09/calorie-reduction-development-tool-updated-Sept-2014.pdf>
- DoH. (2014b). F9. Salt Reduction 2017. Department of Health. Retrieved 15th December 2015, from <https://responsibilitydeal.dh.gov.uk/pledges/pledge/?pl=49>
- DoH. (2015a). Nutrition Legislation Information Sheet. Department of Health. Bulletin October 2015. Retrieved 8th February 2016, from

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/469039/Nutrition_Legislation_Info.pdf

DoH. (2015b). Public Health Responsibility Deal. Pledge F4. Calorie Reduction. from <https://responsibilitydeal.dh.gov.uk/pledges/pledge/?pl=23>

DoH & FSA. (2011). National Diet and Nutrition Survey Headline Results from Years 1, 2 and 3 (Combined) of the Rolling Programme (2008/2009 – 2010/11). A Survey Carried out on Behalf of the Department of Health and the Food Standards Agency. Edited By: Beverley Bates, Alison Lennox, Ann Prentice, Chris Bates, Gillian Swan. Retrieved 3rd December 2015, from <http://www.natcen.ac.uk/media/175123/national-diet-and-nutrition-survey-years-1-2-and-3.pdf>

Doorenbos, C.J. & Vermeij, C.G. (2003). Danger of Salt Substitutes That Contain Potassium in Patients with Renal Failure. Deventer: British Medical Journal.

Driskell, J.A., Schake, M.C. & Detter, H.A. (2008). Using Nutrition Labeling as a Potential Tool for Changing Eating Habits of University Dining Hall Patrons. *Journal of the American Dietetic Association*, 108(12), 2071-2076.

European Commission. (2009). Reformulating Food Products for Health: Context and Key Issues for Moving Forward in Europe. November 2009. from http://ec.europa.eu/health/nutrition_physical_activity/docs/ev20090714_wp_en.pdf

European Commission. (2015). Agriculture and Rural Development - School Fruit Scheme Eu Initiative. Retrieved 3rd January 2016, from http://ec.europa.eu/agriculture/sfs/european-commission/index_en.htm

European Food Information Council. (2010). Food Innovation and Reformulation for a Healthier Europe – a Challenging Mission. Food Today 12/2010. from <http://www.eufic.org/article/en/artid/Food-innovation-reformulation-healthier-Europe-challenging-mission/>

European Food Information Council. (2013). Sugars from a Food Technology Perspective. Food Today 06/2013. Retrieved 8th December 2015, from <http://www.eufic.org/article/en/artid/Sugars-from-a-food-technology-perspective>

European Food Information Council. (2014). Facts on Fats - the Basics. Eufic Review 03/2014. from http://www.eufic.org/article/en/expid/facts_on_fats_the_basics/

European Parliament News. (2016). School Milk and Fruit: Agriculture Meps Promote Healthy Eating. Press Release - Agriculture –Ref. : 20160111ipr09401. from <http://www.europarl.europa.eu/news/en/news-room/20160111IPR09401/School-milk-and-fruit-agriculture-MEPs-promote-healthy-eating>

Fairchild, R.M. & Morgan, M.Z. (2007). Delivering Multidisciplinary Public Health in Action – the Cardiff Food Strategy Case Study. *Public Health Nutrition*, 10(01), 42-48.

FAO & WHO. (1998). Carbohydrates in Human Nutrition. Report of a Joint Fao/Who Expert Consultation. Fao Food and Nutrition Paper. No. 66. Rome: Fao., from <http://www.fao.org/docrep/w8079e/w8079e00.htm>

- Fayle, S.E., Gerrard, J.A. & Chemistry, R.S.o. (2002). *The Maillard Reaction*: Royal Society of Chemistry.
- FDF. (2009). The Biscuit, Cake, Chocolate and Confectionery Sector Group Response. Food and Drink Federation., from <https://www.fdf.org.uk/responses/BC3TR-331-09.pdf>
- FDF. (2015). Salt. Policy Position. Food and Drink Federation. Retrieved 15th December 2015, from <https://www.fdf.org.uk/keyissues.aspx?issue=623>
- Food Agriculture Organization of the United Nations. (1998). *Carbohydrates in Human Nutrition: Report of a Joint Fao/Who Expert Consultation, Rome, 14-18 April 1997*: Food and Agriculture Organization of the United Nations.
- Food Standards Agency in Wales, Welsh Government & PHE. (2015). National Diet and Nutrition Survey Rolling Programme (Ndns Rp) Results from Years 2-5 (Combined) for Wales (2009/10-2012/13). A Survey Carried out on Behalf of the Food Standards Agency in Wales, Welsh Government and Public Health England. Retrieved 10th December 2015, from <http://gov.wales/docs/caecd/research/2015/151209-national-diet-nutrition-survey-rolling-programme-years-2-5-en.pdf>
- Foster, G.D., Makris, A.P. & Bailer, B.A. (2005). Behavioral Treatment of Obesity. *The American Journal of Clinical Nutrition*, 82(1), 230S-235S.
- FSA. (2007a). Trans Fatty Acids. Agency Board Paper on Transfatty Acids Fsa 07/12/07. Retrieved 2nd December 2015, from <http://collections.europarchive.org/tna/20100927130941/http://food.gov.uk/multimedia/pdfs/board/fsa071207.pdf>
- FSA. (2007b). Using Traffic Lights to Make Healthier Choices. Retrieved 2nd December 2015, from <http://tna.europarchive.org/20120419000433/http://www.food.gov.uk/multimedia/pdfs/publication/foodtrafficlight1107.pdf>
- FSA. (2008). Taking Forward the Healthy Food Code of Good Practice. Food Standards Agency. Retrieved 10th January 2016, from <http://webarchive.nationalarchives.gov.uk/20120206100416/http://food.gov.uk/news/newsarchive/2008/jul/healthyfoodcode>
- FSA. (2009). Restaurants and Catering Companies Bring in Calories on Menus. Food Standards Agency. from <http://tna.europarchive.org/20111116080332/http://www.food.gov.uk/news/pressreleases/2009/apr/companiescaloriesmenus>
- FSA. (2010a). Food Standards Agency Salt Commitments (2009-2010). from <http://www.food.gov.uk/sites/default/files/multimedia/pdfs/saltcommitmentsmay2010.pdf>
- FSA. (2010b). Front of Pack (Fop) Nutrition Labelling. from <http://www.food.gov.uk/sites/default/files/multimedia/pdfs/board/fsa100307.pdf>
- FSA. (2014a). Food Information Regulations 2014: Summary Guidance for Food Business Operators and Enforcement Officers in Scotland, Wales and Northern Ireland. Food Standards Agency. Retrieved 10th January 2016, from <https://www.food.gov.uk/sites/default/files/fir-guidance2014.pdf>

- FSA. (2014b). Salt Targets. Food Standards Agency in Northern Ireland., from http://www.food.gov.uk/northern-ireland/nutritionni/salt-ni/salt_targets
- Garrow, J.S. (1992). Treatment of Obesity. *The Lancet*, 340(8816), 409-413.
- Gibney, M.J., Lanham-New, S.A., Cassidy, A. & Vorster, H.H. (2013). *Introduction to Human Nutrition*: Wiley.
- Graves, N., Barnett, A.G., Halton, K.A., Veerman, J.L., Winkler, E., Owen, N., Reeves, M.M., Marshall, A. & Eakin, E. (2009). Cost-Effectiveness of a Telephone-Delivered Intervention for Physical Activity and Diet. *PLoS ONE*, 4(9), e7135.
- Great Britain Panel on DRVs & DoH. (1991). *Dietary Reference Values for Food Energy and Nutrients for the United Kingdom: Report of the Panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy*: H.M. Stationery Office.
- Griffith, R., O'Connell, M. & Smith, K. (2014). The Importance of Product Reformulation Versus Consumer Choice in Improving Diet Quality. Insitute for Fiscal Studies Working Paper W14/15. from <http://www.ifs.org.uk/uploads/publications/wps/wp201415.pdf>
- Grover, S.A., Kaouache, M., Rempel, P., Joseph, L., Dawes, M., Lau, D.C.W. & Lowensteyn, I. (2015). Years of Life Lost and Healthy Life-Years Lost from Diabetes and Cardiovascular Disease in Overweight and Obese People: A Modelling Study. *The Lancet Diabetes & Endocrinology*, 3(2), 114-122.
- Hack, D.M., Bordi, P.L. & Hessert, S.W. (2009). Nutrition, Sensory Evaluation, and Performance Analysis of Trans Fat-Free, Low Alpha-Linolenic Acid Frying Oils. *Journal of Foodservice Business Research*, 12(1), 42-54.
- Hamlin, R.P., McNeill, L.S. & Moore, V. (2015). The Impact of Front-of-Pack Nutrition Labels on Consumer Product Evaluation and Choice: An Experimental Study. *Public Health Nutrition*, 18(12), 2126-2134.
- Hawkes, C. (2013). Promoting Healthy Diets through Nutrition Education and Changes in the Food Environment: An International Review of Actions and Their Effectiveness. Background Paper for the International Conference on Nutrition (Icn2). Food and Agriculture Organization of the United Nations (Fao). from <http://www.fao.org/docrep/017/i3235e/i3235e.pdf>
- Hawkes, C., Jewell, J. & Allen, K. (2013). A Food Policy Package for Healthy Diets and the Prevention of Obesity and Diet-Related Non-Communicable Diseases: The Nourishing Framework. *Obesity Reviews*, 14, 159-168.
- He, F.J., Brinsden, H.C. & MacGregor, G.A. (2014). Salt Reduction in the United Kingdom: A Successful Experiment in Public Health. *J Hum Hypertens*, 28(6), 345-352.
- He, F.J. & MacGregor, G.A. (2009). A Comprehensive Review on Salt and Health and Current Experience of Worldwide Salt Reduction Programmes. *Journal of Human Hypertension*, 23, 363-384.
- Health and Social Care Information Centre. (2013). Children's Dental Health Survey. Executive Summary. England, Wales and Northern Ireland, 2013. Retrieved 17th January 2016, from

<http://www.hscic.gov.uk/catalogue/PUB17137/CDHS2013-Executive-Summary.pdf>

- Health and Social Care Information Centre. (2014). The Health Survey for England 2013. Summary of Key Findings. Retrieved 26th November 2015, from <http://www.hscic.gov.uk/catalogue/PUB16076/HSE2013-Sum-bklet.pdf>
- Henney, J.E., Taylor, C.L. & Boon, C.S. (2010). Strategies to Reduce Sodium Intake in the United States. Washington, DC: The National Academic Press.
- Hooper, L., Abdelhamid, A., Moore, H.J., Douthwaite, W., Skeaff, C.M. & Summerbell, C.D. (2012). Effect of Reducing Total Fat Intake on Body Weight: Systematic Review and Meta-Analysis of Randomised Controlled Trials and Cohort Studies. *BMJ*, 345.
- Hooper, L., Martin, N., Abdelhamid, A. & Davey Smith, G. (2015). Reduction in Saturated Fat Intake for Cardiovascular Disease. *The Cochrane database of systematic reviews*, 6, CD011737.
- House of Commons Health Committee. (2015). Childhood Obesity — Brave and Bold Action. First Report of Session 2015–16. 17 November 2015. Retrieved 8th January 2016, from <http://www.publications.parliament.uk/pa/cm201516/cmselect/cmhealth/465/465.pdf>
- Huang, A., Barzi, F., Huxley, R., Denyer, G., Rohrlach, B., Jayne, K. & Neal, B. (2006). The Effects on Saturated Fat Purchases of Providing Internet Shoppers with Purchase-Specific Dietary Advice: A Randomised Trial. *PLOS Clin Trial*, 1(5), e22.
- Hubert, H.B., Feinleib, M., McNamara, P.M. & Castelli, W.P. (1983). Obesity as an Independent Risk Factor for Cardiovascular Disease: A 26-Year Follow-up of Participants in the Framingham Heart Study. *Circulation*, 67(5), 968-977.
- Ikehara, S., Hiroyasu, I., Date, C., Kikuchi, S., Yoshiyuki, W., Inaba, Y. & Tamkoshi, A. (2012). Salt Preference and Mortality from Stroke and Coronary Heart Disease for Japanese Men and Women. *Preventive Medicine*, 32-37.
- Obesity in Europe: A Joint Paper from the Irish Medical Organisation and the British Medical Association Northern Ireland (2010).
- Jakobsen, M.U., O'Reilly, E.J., Heitmann, B.L., Pereira, M.A., Bälter, K., Fraser, G.E., Goldbourt, U., Hallmans, G., Knekt, P., Liu, S., Pietinen, P., Spiegelman, D., Stevens, J., Virtamo, J., Willett, W.C. & Ascherio, A. (2009). Major Types of Dietary Fat and Risk of Coronary Heart Disease: A Pooled Analysis of 11 Cohort Studies. *The American Journal of Clinical Nutrition*, 89(5), 1425-1432.
- JamieOliver.com. (2015). Jamie's Recommendations to Help Combat Childhood Obesity in the UK. from <http://www.jamieoliver.com/news-and-features/features/jamies-plan-to-combat-childhood-obesity/#RGoSPR1x1hsY4EiK.99>
- Janz, N.K. & Becker, M.H. (1984). The Health Belief Model: A Decade Later. *Health Education & Behavior*, 11(1), 1-47.

- Jiménez Colmenero, F. (2000). Relevant Factors in Strategies for Fat Reduction in Meat Products. *Trends in Food Science & Technology*, 11(2), 56-66.
- John C. Kozup, Elizabeth H. Creyer & Burton, S. (2003). Making Healthful Food Choices: The Influence of Health Claims and Nutrition Information on Consumers' Evaluations of Packaged Food Products and Restaurant Menu Items. *Journal of Marketing*, 67(2), 19-34.
- Johnson, R.J., Segal, M.S., Sautin, Y., Nakagawa, T., Feig, D.I., Kang, D.-H., Gersch, M.S., Benner, S. & Sánchez-Lozada, L.G. (2007). Potential Role of Sugar (Fructose) in the Epidemic of Hypertension, Obesity and the Metabolic Syndrome, Diabetes, Kidney Disease, and Cardiovascular Disease. *The American Journal of Clinical Nutrition*, 86(4), 899-906.
- Johnson, R.K., Appel, L.J., Brands, M., Howard, B.V., Lefevre, M., Lustig, R.H., Sacks, F., Steffen, L.M., Wylie-Rosett, J., on behalf of the American Heart Association Nutrition Committee of the Council on Nutrition, P.A., Metabolism, Epidemiology, t.C.o. & Prevention. (2009). Dietary Sugars Intake and Cardiovascular Health: A Scientific Statement from the American Heart Association. *Circulation*, 120(11), 1011-1020.
- Joy, A., Pradhan, V. & Goldman, G. (2006). Cost-Benefit Analysis Conducted for Nutrition Education in California. *California Agriculture*, 60(4), 185-191.
- Kantar Worldpanel. (2014). Kantar Worldpanel, Sample of 27,000 Households in England, January 2013/January 2014. Cited In: Phe (2014) Sugar Reduction: Responding to the Challenge Retrieved 8th January 2016, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/324043/Sugar_Reduction_Responding_to_the_Challenge_26_June.pdf
- Kantar Worldpanel. (2015). Grocery Shopping in Wales. Retrieved 5th February 2016, from <http://businesswales.gov.wales/foodanddrink/sites/fooddrink/files/Kantar%20Sub%20Sector%20slides%20-%20Grocery%20Shopping%20in%20Wales%20FINAL%20Presentation.pdf>
- Keast, R. (2010). Salt; Health, Functionality and Flavor. Nu-Tek Products. Retrieved 20th November 2015, from http://www.malabarsuperspice.com/docs/salt_DrKeast_Literature_Review.pdf
- Kelly, B., Hughes, C., Chapman, K., Louie, J.C.-Y., Dixon, H., Crawford, J., King, L., Daube, M. & Slevin, T. (2009). Consumer Testing of the Acceptability and Effectiveness of Front-of-Pack Food Labelling Systems for the Australian Grocery Market. *Health Promotion International*, 24(2), 120-129.
- Knai, C., Petticrew, M., Durand, M.A., Eastmure, E., James, L., Mehrotra, A., Scott, C. & Mays, N. (2015). Has a Public–Private Partnership Resulted in Action on Healthier Diets in England? An Analysis of the Public Health Responsibility Deal Food Pledges. *Food Policy*, 54, 1-10.
- Kumanyika, S.K. & Obarzanek, E. (2003). Pathways to Obesity Prevention: Report of a National Institutes of Health Workshop1. *Obesity Research*, 11(10), 1263-1274.

- Lee, S., Kim, S. & Inglett, G.E. (2005). Effect of Shortening Replacement with Oatrim on the Physical and Rheological Properties of Cakes. *Cereal Chemistry Journal*, 82(2), 120-124.
- Lloyd-Williams, F., Bromley, H., Orton, L., Hawkes, C., Taylor-Robinson, D., O'Flaherty, M., McGill, R., Anwar, E., Hyseni, L., Moonan, M., Rayner, M. & Capewell, S. (2014). Smorgasbord or Symphony? Assessing Public Health Nutrition Policies across 30 European Countries Using a Novel Framework. *BMC Public Health*, 14(1), 1-20.
- Madden, T.J., Ellen, P.S. & Ajzen, I. (1992). A Comparison of the Theory of Planned Behavior and the Theory of Reasoned Action. *Personality and Social Psychology Bulletin*, 18(1), 3-9.
- Magnus, A., Haby, M.M., Carter, R. & Swinburn, B. (2009). The Cost-Effectiveness of Removing Television Advertising of High-Fat and/or High-Sugar Food and Beverages to Australian Children. *Int J Obes*, 33(10), 1094-1102.
- Marshall, D.L. & Bullerman, L.B. (1994). Antimicrobial Properties of Sucrose Fatty Acid Esters. In C.C. Akoh (Ed.), *Carbohydrate Polyesters as Fat Substitutes*: Taylor & Francis.
- Mente, A., de Koning, L., Shannon, H.S. & Anand, S.S. (2009). A Systematic Review of the Evidence Supporting a Causal Link between Dietary Factors and Coronary Heart Disease. *Archives of Internal Medicine*, 169(7), 659-669.
- Mintel Group Ltd. (2014). Fruit Juice, Juice Drinks and Smoothies - Uk - November 2014. from <http://academic.mintel.com.ezproxy.cardiffmet.ac.uk/display/679638/>
- Mitchell, H. (2008). *Sweeteners and Sugar Alternatives in Food Technology*: Wiley-Blackwell.
- Mozaffarian, D., Katan, M.B., Ascherio, A., Stampfer, M.J. & Willett, W.C. (2006). Trans Fatty Acids and Cardiovascular Disease. *New England Journal of Medicine*, 354(15), 1601-1613.
- Murcott, A., Belasco, W. & Jackson, P. (2013). *The Handbook of Food Research*: Bloomsbury Academic.
- Muse, M.R. & Hartel, R.W. (2004). Ice Cream Structural Elements That Affect Melting Rate and Hardness. *Journal of Dairy Science*, 87(1), 1-10.
- National Assembly for Wales. (2013). Inquiry into the Implementation of the National Service Framework for Diabetes in Wales and Its Future Direction. Health and Social Care Committee. June 2013. from <http://www.assembly.wales/Laid%20Documents/CR-LD9366%20-%20Health%20and%20Social%20Care%20Committee%20Report%20into%20the%20implementation%20of%20the%20National%20Service%20Framework%20f-24062013-247323/cr-ld9366-e-English.pdf>
- National Assembly for Wales. (2015). Well-Being of Future Generations (Wales) Act 2015. 2015 *anaw* 2. Retrieved 9th October 2015, from <http://www.legislation.gov.uk/anaw/2015/2/contents/enacted>
- National Centre for Social Research. (2007). An Assessment of Dietary Sodium Levels among Adults (Aged 19–64) in the General Population in Wales,

- Based on Analysis of Dietary Sodium in 24-Hour Urine Samples. Joint Health Surveys Unit. Retrieved 3rd December 2015, from <http://webarchive.nationalarchives.gov.uk/20101211052406/http://www.food.gov.uk/multimedia/pdfs/walessodiumreport.pdf>
- National Food Survey. (1940-2000). Archived National Food Survey Data. Retrieved 24th April 2014, from <https://discover.ukdataservice.ac.uk/series/?sn=2000034>
- Ng, S., Ni Mhurchu, C., Jebb, S. & Popkin, B. (2012). Patterns and Trends of Beverage Consumption among Children and Adults in Great Britain, 1986-2009. *British Journal of Nutrition*, 108(03), 536-551.
- NHS. (2015). Why 5 a Day? Retrieved 8th January 2016, from <http://www.nhs.uk/Livewell/5ADAY/Pages/Why5ADAY.aspx>
- Nuraida, L. (2015). A Review: Health Promoting Lactic Acid Bacteria in Traditional Indonesian Fermented Foods. *Food Science and Human Wellness*, 4(2), 47-55.
- Oddy, P.D.J. & Atkins, P.P.J. (2012). Conc;Usion. In V. Amilien, P.D.J. Oddy & P.P.J. Atkins (Eds.), *The Rise of Obesity in Europe: A Twentieth Century Food History* (pp. 262). Surrey: Ashgate Publishing Limited.
- Panjwani, C. & Caraher, M. (2013). The Public Health Responsibility Deal: Brokering a Deal for Public Health, but on Whose Terms? *Health Policy*, 114(2), 163-173.
- Paramithiotis, S. (2016). *Lactic Acid Fermentation of Fruits and Vegetables*: Taylor & Francis.
- Perrett, M. (2015). Food and Drink Focus for Child Obesity. . Retrieved 6, from http://www.foodmanufacture.co.uk/Regulation/Childhood-obesity-strategy-what-s-on-the-way?utm_source=copyright&utm_medium=OnSite&utm_campaign=copyright
- PHE. (2014a). Ndns Results from Years 1 to 4 Combined of the Rolling Programme for 2008 and 2009 to 2011 and 2012: Report. Retrieved 2nd December 2015, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/310995/NDNS_Y1_to_4_UK_report.pdf
- PHE. (2014b). Sugar Reduction: Responding to the Challenge. Retrieved 8th January 2016, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/324043/Sugar_Reduction_Responding_to_the_Challenge_26_June.pdf
- PHE. (2015a). Change4life Sugar Smart. Retrieved 13th January 2016, from <https://www.nhs.uk/change4life-beta/campaigns/sugar-smart/home>
- PHE. (2015b). Sugar Reduction. The Evidence for Action. Public Health England. October 2015. from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/470179/Sugar_reduction_The_evidence_for_action.pdf
- PHE. (2015c). Why 5%? An Explanation of Sacn's Recommendations About Sugars and Health. Ref: Phe Publications Gateway Number 2015193. Retrieved

- 30th November 2015, from [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446010/Why_5 - The Science Behind SACN.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446010/Why_5_-_The_Science_Behind_SACN.pdf)
- Physical Activity and Nutrition Networks Wales. (2015). Nutrition Campaigns. from <http://www.physicalactivityandnutritionwales.org.uk/page.cfm?orgid=740&pid=29611>
- Potter, N.N. & Hotchkiss, J.H. (1998). *Food Science*: Springer US.
- Prentice, A.M. & Jebb, S.A. (1995). Obesity in Britain: Gluttony or Sloth? *British Medical Journal*, 311, 437-439.
- Public Health Wales NHS Trust. (2015). Child Measurement Programme for Wales 2013/2014. from [http://www2.nphs.wales.nhs.uk:8080/ChildMeasurementDocs.nsf/61c1e930f9121fd080256f2a004937ed/692fe9649b4fc8be80257e49002a4bcb/\\$FILE/ATT0SH7G.pdf](http://www2.nphs.wales.nhs.uk:8080/ChildMeasurementDocs.nsf/61c1e930f9121fd080256f2a004937ed/692fe9649b4fc8be80257e49002a4bcb/$FILE/ATT0SH7G.pdf)
- Pulos, E. & Leng, K. (2010). Evaluation of a Voluntary Menu-Labeling Program in Full-Service Restaurants. *American Journal of Public Health*, 100(6), 1035-1039.
- Reilly, J.J., Methven, E., McDowell, Z.C., Hacking, B., Alexander, D., Stewart, L. & Kelnar, C.J.H. (2003). Health Consequences of Obesity. *Archives of Disease in Childhood*, 88(9), 748-752.
- Research and Markets. (2015). Sugar Substitutes Market by Type, Composition, Application, & by Region - Forecast to 2020. Id: 3493716 November 2015. from <http://www.researchandmarkets.com/reports/3493716/sugar-substitutes-market-by-type-composition#description>
- Research and Markets. (2016). Low Intensity Sweeteners Market by Type (Xylitol, Tagatose, Allulose, Trehalose, & Isomaltulose), Application, & by Geography - Global Trends & Forecasts to 2020. Id: 3608027 January 2016.
- Roberto, C., Wong, D., Musicus, A. & Hammond, D. (2016). The Influence of Sugar-Sweetened Beverage Health Warning Labels on Parents' Choices. *Pediatrics*, 137(2).
- Robinson, J. (2001). *Food Technology*: Nelson Thornes.
- Rodrigues, F.M., Rosenthal, A., Tiburski, J.H. & Cruz, A.G.D. (2015). *Alternatives to Reduce Sodium in Processed Foods and the Potential of High Pressure Technology* Vol. [online] ahead of print *Food Science and Technology Campinas* Retrieved from <http://www.scielo.br/pdf/cta/2015nahead/0101-2061-cta-1678-457X6833.pdf>
- Rodríguez-García, J., Puig, A., Salvador, A. & Hernando, I. (2012). Optimization of a Sponge Cake Formulation with Inulin as Fat Replacer: Structure, Physicochemical, and Sensory Properties. *Journal of Food Science*, 77(2), C189-C197.
- Ronit, K. & Jensen, J.D. (2014). Obesity and Industry Self-Regulation of Food and Beverage Marketing: A Literature Review. *Eur J Clin Nutr*, 68(7), 753-759.
- Roos, G. (2012). Food Labelling for Health in the Light of Norwegian Nutrition Policy. In V. Amilien, P.D.J. Oddy & P.P.J. Atkins (Eds.), *The Rise of Obesity in*

- Europe: A Twentieth Century Food History* (pp. 262). Surrey: Ashgate Publishing Limited.
- Rutter, D. & Quine, L. (2002). Social Cognition Models and Changing Health Behaviours. In D. Rutter & L. Quine (Eds.), *Changing Health Behaviour Intervention and Research with Social Cognition Models* (1st ed.). Buckingham, England: Open University Press.
- Ruusunen, M. & Puolanne, E. (2005). Reducing Sodium Intake from Meat Products. *Meat Science*, 70, 531–541.
- Ruusunen, M., Vainionpaa, J., Lyly, M., Lahteenmaki, L., Niemisto, M., Ahvenainen, R. & Puolanne, E. (2005). Reducing the Sodium Content in Meat Products: The Effect of the Formulation in Low-Sodium Ground Meat Patties. *Meat Science*, 69, 53-60.
- Sacks, G., Rayner, M. & Swinburn, B. (2009). Impact of Front-of-Pack 'Traffic-Light' Nutrition Labelling on Consumer Food Purchases in the Uk. *Health Promotion International*, 24(4), 344-352.
- SACN. (2003). Salt and Health. Scientific Advisory Committee on Nutrition. London: The Stationery Office. Retrieved 2nd December 2015, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/338782/SACN_Salt_and_Health_report.pdf
- SACN. (2007). Update on Trans Fatty Acids and Health. Position Statement by the Scientific Advisory Committee on Nutrition. The Stationery Office. from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/339359/SACN_Update_on_Trans_Fatty_Acids_2007.pdf
- SACN. (2015a). Carbohydrates and Health. Scientific Advisory Committee on Nutrition, London: Tso. Retrieved 9th January 2016, from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/445503/SACN_Carbohydrates_and_Health.pdf
- SACN. (2015b). Minutes of the 1st Sacn Fat Working Group Meeting. 26th October 2015. Retrieved 8th February 2016, from <https://app.box.com/s/e2d90rtsig2mjgjk6bwsd5tk5isx8w/1/4906304085/45705196221/1>
- Sadler, K., Nicholson, S., Steer, T., Gill, V., Bates, B., Tipping, S., Cox, L., Lennox, A. & A., P. (2011). National Diet and Nutrition Survey - Assessment of Dietary Sodium in Adults (Aged 19 to 64 Years) in England, 2011. A Survey Carried out on Behalf of the Department of Health. London: Department of Health. from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/213420/Sodium-Survey-England-2011_Text_to-DH_FINAL1.pdf
- Sahi, S., Gates, F. & Maher, N. (2013). Determination of Bulk and Interfacial Properties of Wheat Flour/Water Systems. Campden Bri. R&D Report 339.
- Salt Institute. (2013). Food Research. Salt and Food Technology by the Salt Institute - July 3, 2013. Retrieved 13th December 2015, from <http://www.saltinstitute.org/research/salt-and-food-technology/>

- Sanchez-Castillo, C.P., Warrender, S., Whitehead, T.P. & James, W.P.T. (1987). An Assessment of the Sources of Dietary Salt in a British Population. *Clinical Science*, 72(1), 95-102.
- Schönfeldt, H.C., Hall, N. & Bester, M. (2013). Relevance of Food-Based Dietary Guidelines to Food and Nutrition Security: A South African Perspective. *Nutrition Bulletin*, 38(2), 226-235.
- Schwarzer, R. & Luszczynska, A. (2008). How to Overcome Health-Compromising Behaviors. *European Psychologist*, 13(2), 141-151.
- ScienceDaily. (2016). Health Warning Labels May Deter Parents from Purchasing Sugar-Sweetened Beverages for Kids: Warnings Similar to Those Found on Tobacco Products May Help Educate Parents of Health Risks Such as Diabetes and Obesity. University of Pennsylvania School of Medicine. Sciencedaily, 14 January 2016. Retrieved 16th January 2016, from www.sciencedaily.com/releases/2016/01/160114100735.htm
- Selmer, R.M., Kristiansen, I.S., Haglerød, A., Graff-Iversen, S., Larsen, H.K., Meyer, H.E., Børnaa, K.H. & Thelle, D.S. (2000). Cost and Health Consequences of Reducing the Population Intake of Salt. *Journal of Epidemiology and Community Health*, 54(9), 697-702.
- Senate Bill No. 1000. (2014). Public Health: Sugar-Sweetened Beverages: Safety Warnings. California Legislature. from http://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1000.
- Senate Bill No. A02320. (2014). Requires Sugar-Sweetened Beverages to Be Labeled with a Safety Warning. State of New York. from http://assembly.state.ny.us/leg/?default_fld=%0D%0A&bn=A02320&term=2015&Summary=Y&Actions=Y&Votes=Y&Text=Y
- Shils, M.E. & Shike, M. (2006). *Modern Nutrition in Health and Disease*: Lippincott Williams & Wilkins.
- Skeaff, C.M. & Miller, J. (2009). Dietary Fat and Coronary Heart Disease: Summary of Evidence from Prospective Cohort and Randomised Controlled Trials. *Annals of Nutrition and Metabolism*, 55(1-3), 173-201.
- Speirs, C. & Bishop, H. (2013). Development of Reduced Fat Cakes. Campden Bri. R&D Report No. 352. Project 125501.
- Stein, L.J., Cowart, B.J. & Beauchamp, G.K. (2012). The Development of Salty Taste Acceptance Is Related to Dietary Experience in Human Infants: A Prospective Study. *The American Journal of Clinical Nutrition*, 95(1), 123-129.
- Sullivan, P.W., Ghushchyan, V.H. & Ben-Joseph, R. (2008). The Impact of Obesity on Diabetes, Hyperlipidemia and Hypertension in the United States. *Quality of Life Research*, 17(8), 1063-1071.
- Supornsilaphachai, C. (2013). Evolution of Salt Reduction Initiatives in Thailand: Lessons for Other Countries in the South-East Asia Region. *WHO Regional Health Forum*, 17(1), 61-71.

- Tate, D.F., Jackvony, E.H. & Wing, R.R. (2003). Effects of Internet Behavioral Counseling on Weight Loss in Adults at Risk for Type 2 Diabetes: A Randomized Trial. *JAMA*, 289(14), 1833-1836.
- Taylor, D., Bury, M., Campling, N., Carter, S., Garfield, S., Newbould, J. & Rennie, T. (2006). A Review of the Use of the Health Belief Model (Hbm), the Theory of Reasoned Action (Tra), the Theory of Planned Behaviour (Tpb) and the Trans-Theoretical Model (Ttm) to Study and Predict Health Related Behaviour Change. *National Institute for Health and Clinical Excellence (NICE) guidelines: Behaviour change: the principles for effective interventions*. Retrieved 8th August 2014, from <https://www.nice.org.uk/guidance/ph6/resources/behaviour-change-taylor-et-al-models-review2>
- Temme, E.H., van der Voet, H., Roodenburg, A.J., Bulder, A., van Donkersgoed, G. & van Klaveren, J. (2011). Impact of Foods with Health Logo on Saturated Fat, Sodium and Sugar Intake of Young Dutch Adults. *Public Health Nutrition*, 14(04), 635-644.
- The Scottish Government. (2014). Obesity Indicators 2014: Monitoring Progress for the Prevention of Obesity Route Map. An Official Statistics Publication for Scotland. Publication Date: 2 December 2014. *Statistical Bulletin: Health & Social Care Series*. Retrieved 26th November 2015, from <http://www.gov.scot/Publications/2014/12/4260>
- The Sugar Association. (n.d.). Sugar's Functional Roles in Cooking & Food Preparation. Retrieved 8th December 2015, from <http://www.sugar.org/images/docs/sugar-functional-roles.pdf>
- The Sugar Reduction Summit. (2015, 7th December 2015). *The Sugar Reduction Summit; Sugar, Sweetness and Obesity*, The Royal Society of Medicine.
- Thow, A.M., Jan, S., Leeder, S. & Swinburn, B. (2010). The Effect of Fiscal Policy on Diet, Obesity and Chronic Disease: Systematic Review. *Bulletin of the World Health Organization*, 88, 609-614.
- Trieu, K., Neal, B., Hawkes, C., Dunford, E., Campbell, N., Rodriguez-Fernandez, R., Legetic, B., McLaren, L., Barberio, A. & Webster, J. (2015). Salt Reduction Initiatives around the World – a Systematic Review of Progress Towards the Global Target. *PLoS ONE*, 10(7).
- Uauy, R., Aro, A., Clarke, R., Ghafoorunissa, L'Abbe, M.R., Mozaffarian, D., Skeaff, C.M., Stender, S. & Tavella, M. (2009). Who Scientific Update on Trans Fatty Acids: Summary and Conclusions. *European Journal of Clinical Nutrition*, 63(S2), S68-S75.
- UK Parliament. (2015). Commons Select Committee. Public Health England and Jamie Oliver Discuss Childhood Obesity Strategy. 15th October 2015. Retrieved 13th January 2016, from <http://www.parliament.uk/business/committees/committees-a-z/commons-select/health-committee/news-parliament-2015/childhood-obesity-strategy-second-evidence-session-15-16/>
- van Raaij, J., Hendriksen, M. & Verhagen, H. (2009). Potential for Improvement of Population Diet through Reformulation of Commonly Eaten Foods. *Public Health Nutrition*, 12(03), 325-330.

- Villela, P.T.M., Villela, P.T.M., Ferriolli, E., Oliveira, E., Morguti, J.C., Lima, N.K.C., Bertani, J.M.T. & Bonardi, R.T.M. (2014). Salt Preference in Hypertensive and Normotensive, Older and Younger Individuals. *Journal of the American Society of Hypertension*.
- WASH. (2015). Wash Aims. World Action on Salt and Health. . Retrieved 16th December 2015, from <http://www.worldactiononsalt.com/about/aims/index.html>
- Watkins, P. & Jones, H. (2015). A Picture of Diabetes in Wales. *In Brief*. Retrieved 26th November 2015, from <https://assemblyinbrief.wordpress.com/2015/11/16/a-picture-of-diabetes-in-wales/>
- Webb, G.P. (2012). *Nutrition: Maintaining and Improving Health, Fourth Edition*: CRC Press.
- Webster, J.L., Dunford, E.K., Hawkes, C. & Neal, B.C. (2011). Salt Reduction Initiatives around the World. *Journal of Hypertension*, 29(6), 1043-1050.
- Welsh Assembly Government. (2008). Appetite for Life Action Plan. from [http://www.physicalactivityandnutritionwales.org.uk/Documents/740/Appetite%20for%20life%20actionplan%20\(E\).pdf](http://www.physicalactivityandnutritionwales.org.uk/Documents/740/Appetite%20for%20life%20actionplan%20(E).pdf)
- Welsh Assembly Government. (2009). Food and Health Guidelines for Early Years and Childcare Settings. Health Challenge Wales. Retrieved 10th January 2016, from <http://gov.wales/docs/phhs/publications/foodandhealth/090414guidelinesen.pdf>
- Welsh Government. (2012a). Guidance on Healthier Food and Drink in Leisure Centres. from <http://gov.wales/docs/phhs/publications/120912leisureguideen.pdf>
- Welsh Government. (2012b). Guidance on Healthier Food and Drink in Youth Work Settings. from <http://gov.wales/docs/phhs/publications/120912youthguideen.pdf>
- Welsh Government. (2012c). Health Promoting Hospital Vending Guidance. from <http://gov.wales/docs/phhs/publications/120618hospitalvendingguidanceen.pdf>
- Welsh Government. (2014). Free Breakfast in Primary Schools. Statutory Guidance for Local Authorities and Governing Bodies. Guidance Document No: 145/2014. from <http://learning.gov.wales/docs/learningwales/publications/140627-free-breakfast-primary-guidance-en.pdf>
- Welsh Government. (2015a). Corporate Health Standard: A Quality Framework and Award for Health and Wellbeing in the Workplace. from <http://gov.wales/docs/phhs/publications/151126corporatehealthstandardsen.pdf>
- Welsh Government. (2015b). Statistical Bulletin. Welsh Health Survey 2014: Health-Related Lifestyle Results. Sb 30/2015. Retrieved 9th October 2015, from <http://gov.wales/docs/statistics/2015/150603-welsh-health-survey-2014-health-related-lifestyle-en.pdf>

- Welsh Statutory Instrument. (2009). The Food Labelling (Nutrition Information) (Wales) Regulations 2009. No. 2705 (W.224) Retrieved 8th February 2016, from [http://www.assembly.wales/Laid%20Documents/SUB-LD7727%20-%20The%20Food%20Labelling%20\(Nutrition%20Information\)%20\(Wales\)%20Regulations%202009-06102009-145652/sub-ld7727-e-English.pdf](http://www.assembly.wales/Laid%20Documents/SUB-LD7727%20-%20The%20Food%20Labelling%20(Nutrition%20Information)%20(Wales)%20Regulations%202009-06102009-145652/sub-ld7727-e-English.pdf)
- Welsh Statutory Instrument. (2014). The Food Information (Wales) Regulations 2014. No. 2303 (W. 227). Retrieved 8th February 2016, from http://www.legislation.gov.uk/wsi/2014/2303/pdfs/wsi_20142303_mi.pdf
- WHO. (2004). Global Strategy on Diet, Physical Activity and Health. World Health Organization. Geneva: World Health Organization. Retrieved 1st December 2015, from http://apps.who.int/iris/bitstream/10665/43035/1/9241592222_eng.pdf?ua=1
- WHO. (2010). Fats and Fatty Acids in Human Nutrition. Report of an Expert Consultation. Fao Food and Nutrition Paper 91. Retrieved 13th December 2015, from <http://foris.fao.org/preview/25553-0ece4cb94ac52f9a25af77ca5cfba7a8c.pdf>
- WHO. (2012a). Guideline: Potassium Intake for Adults and Children. World Health Organization, Geneva. from http://www.who.int/nutrition/publications/guidelines/potassium_intake_printversion.pdf
- WHO. (2012b). Guideline: Sodium Intake for Adults and Children. from http://www.who.int/nutrition/publications/guidelines/sodium_intake_printversion.pdf
- WHO. (2013). Marketing of Foods High in Fat, Salt and Sugar to Children: Update 2012–2013. Who European Network on Reducing Food Marketing Pressure on Children. from http://www.euro.who.int/_data/assets/pdf_file/0019/191125/e96859.pdf
- WHO. (2014a). Protecting Children from the Harmful Effects of Food and Drink Marketing. Features September 2014. Geneva: World Health Organization., from <http://www.who.int/features/2014/uk-food-drink-marketing/en/#>
- WHO. (2014b). Salt Reduction. Fact Sheet N°393. Geneva: World Health Organization. Retrieved 2nd December 2015, from <http://www.who.int/mediacentre/factsheets/fs393/en>
- WHO. (2015a). Healthy Diet. Fact Sheet N°394. Geneva: World Health Organization. Retrieved 2nd December 2015, from <http://www.who.int/mediacentre/factsheets/fs394/en/>
- WHO. (2015b). Obesity and Overweight. Fact Sheet N°311. Geneva: World Health Organization. Retrieved 26th November 2015, from <http://www.who.int/mediacentre/factsheets/fs311/en/>
- WHO. (2015c). Sugars Intake for Adults and Children. Geneva: World Health Organization., from http://apps.who.int/iris/bitstream/10665/149782/1/9789241549028_eng.pdf?ua=1
- Wilson, R., Komitopoulou, E. & Incles, M. (2012). Evaluation of Technological Approaches to Salt Reduction. Leatherhead Food Research. Food and Drink

- Federation and British Retail Consortium. July 2012. from http://www.brc.org.uk/downloads/Leatherhead_Salt_Research.pdf
- Wootan, M.G., Reger-Nash, B., Booth-Butterfield, S. & Cooper, L. (2005). The Cost-Effectiveness of 1% or Less Media Campaigns Promoting Low-Fat Milk Consumption. *Preventing Chronic Disease*, 2(4), A05.
- Wu, H., Zhang, Y., Long, M., Tang, J., Yu, X., Wang, J. & Zhang, J. (2014). Proteolysis and Sensory Properties of Dry-Cured Bacon as Affected by the Partial Substitution of Sodium Chloride with Potassium Chloride. *Meat Science*, 96(3), 1325-1331.
- Yasir, S.B.M., Sutton, K.H., Newberry, M.P., Andrews, N.R. & Gerrard, J.A. (2007). The Impact of Maillard Cross-Linking on Soy Proteins and Tofu Texture. *Food Chemistry*, 104(4), 1502-1508.
- Zambrano, F., Despinoy, P., Ormenese, R.C.S.C. & Faria, E.V. (2004). The Use of Guar and Xanthan Gums in the Production of 'Light' Low Fat Cakes. *International Journal of Food Science & Technology*, 39(9), 959-966.

8. Appendix: Research Commissioned for this Report

8.1 Methodology

In-depth literature reviews were conducted for the collation of information for elements one and two of this report.

The information collated in element one informed the development of a self-complete questionnaire, to determine the perceptions, awareness and preferences of consumers in Wales for policies and interventions regarding salt, fat and sugar reduction in food products.

The questionnaire was piloted with five consumers meeting the inclusion criteria (over 18 years of age and living in Wales). This allowed for the validity and reliability of the questionnaire to be determined. Content validity was determined in a structured meeting held by the research team. Following piloting, minor amendments to the questionnaire were implemented. The questionnaire was available online, using the Qualtrics Research Suite software (Qualtrics, Provo, Utah, USA). The questionnaire was complete by 122 consumers in Wales.

The information collated in element two informed the development of an interview schedule to gain an in-depth understanding of the experiences of food and drink manufacturing and processing businesses in Wales regarding product reformulation. In-depth interviews were conducted with five food and drink manufacturing and processing businesses in Wales and two independent food industry technologists specialising in product reformulation.

8.2 Results

A total of 122 consumers in Wales completed the questionnaire on food, health and nutrition. The methodology of which has been detailed in Section 2. The majority of questionnaire respondents (59%) were female, 34% were male and 7% did not wish to disclose their gender. Figure 18 indicates the age distribution of the questionnaire respondents. The greatest proportion of respondents were aged 40 – 49 years.

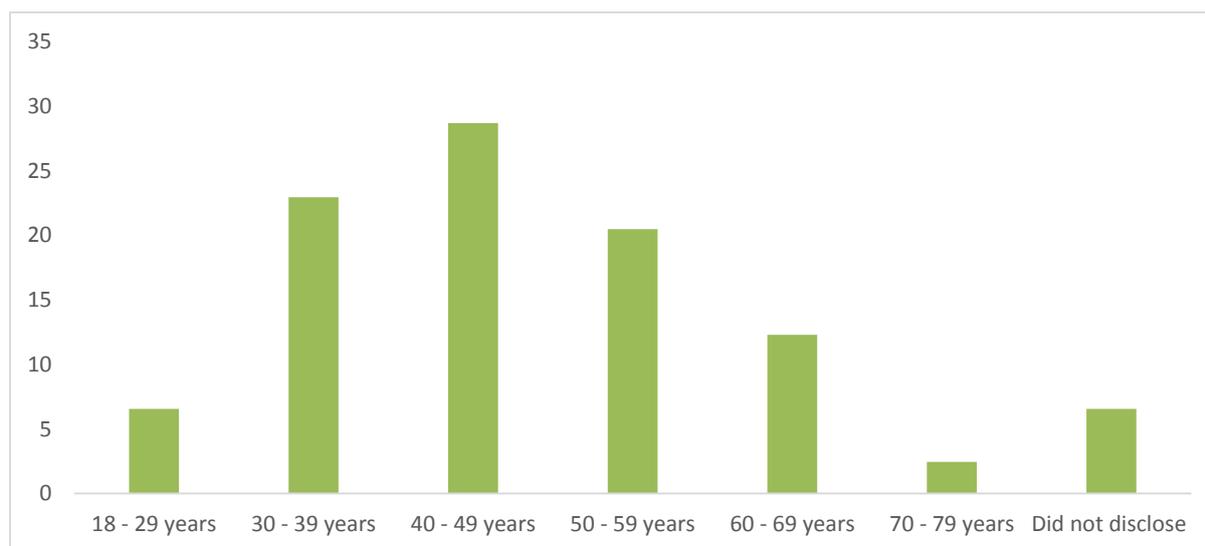


Figure 18: Age distribution of respondents (n=122)

Most respondents reported to live with others, 49% with other and no children, 32% with others including children, 12% reported to live alone and 11% did not disclose information regarding their households.

8.2.1 Perceptions of risk, control and responsibility for sugar, fat and salt consumption

The perceived level of risk to health from eating sugar, salt and fat and the associated levels of control and responsibility were determined using a 10-point variation of a visual analogue scale. The cumulative mean scores for perceived risk, control and responsibility were calculated and percentages for grouped results are indicated in Table 8.

Although total fat was perceived to have the lowest level of risk to health (Mean 6.3), trans-fat (Mean 7.8) and saturated fat (Mean 7.4) were perceived to have the greatest risk to health of the key nutrients with around two-thirds of respondents (59.2 – 61.3%) ranking them as being 'high – very high' risk. However, respondents perceived

themselves to have marginally greater levels of control for the amount of fat they consume (Mean 7.0 – 7.1) compared to sugar and salt (Mean 6.8). Although the majority (60.5 – 69.2%) perceived themselves to have near total responsibility for the amount of sugar, salt and fat they consume, the lowest perceived responsibility was for trans-fat.

Table 8: Perception of risk, control and responsibility for consumption of sugar, fat and salt

	What do you perceive to be the level of risk to your health from eating sugar, salt and fat? 1: Very low risk 10: Very high risk					How much control do you believe you have in the amount of sugar, salt and fat that you eat? 1: No control 10: Total control					How much responsibility do you believe you have in the amount of sugar, salt and fat that you eat? 1: No responsibility 10: Total responsibility			
	<i>n</i>	Mean	Std dev	Ranked 1-3 (%)	Ranked 8-10 (%)	<i>n</i>	Mean	Std dev	Ranked 1-3 (%)	Ranked 8-10 (%)	<i>n</i>	Mean	Std dev	Ranked 1-3 (%)
	Sugar	121	7.0	2.2	8.3	48.8	122	6.8	2.3	10.7	45.9	120	8.3	1.9
Salt	121	6.7	2.2	9.9	40.5	122	6.8	2.1	8.2	39.3	119	8.2	1.9	4.2
Total fat	121	6.3	2.3	13.2	30.6	122	7.1	2.0	5.7	47.5	120	8.3	1.8	2.5
Saturated fat	120	7.4	2.2	8.3	59.2	119	7.1	2.0	5.9	50.4	118	8.2	1.9	3.4
Trans-fat	111	7.8	2.1	4.5	61.3	113	7.0	2.3	10.6	50.4	114	8.0	2.1	4.4

The relationship between perceived levels of risk, control and responsibility for consumption of sugar, fat and salt was investigated using the Spearman’s rho. Significant correlations are detailed in Table 9. Strong positive correlations were determined between perceived control and responsibility for all nutrients, with high levels of responsibility associated with high levels of perceived control. A small negative correlation was also determined between the perceived risk and control of saturated fat consumption with higher levels of risk associated with lower levels of control.

Table 9: Significant relationships between perceptions of risk, control and responsibility

Nutrient	Risk/Control	Risk/Responsibility	Control/Responsibility
Sugar	No correlation	No correlation	$r = 0.53, n = 120, p < 0.001$ Strong positive correlation
Salt	No correlation	No correlation	$r = 0.54, n = 119, p < 0.001$ Strong positive correlation
Total fat	No correlation	No correlation	$r = 0.52, n = 120, p < 0.001$ Strong positive correlation
Saturated fat	$r = -0.22, n = 119, p < 0.05$ Small negative correlation	No correlation	$r = 0.57, n = 117, p < 0.001$ Strong positive correlation
Trans-fat	No correlation	No correlation	$r = 0.69, n = 111, p < 0.001$ Strong positive correlation

Between a quarter and a third of respondents indicated willingness to pay more for food products with reduced salt, fat and sugar content. No significant relationships ($p > 0.05$) were determined between willingness to pay and gender or household demographic. The greatest reported willingness to pay more, was for food products with no trans-fats. A greater number of respondents reported a willingness to pay more for food products containing no trans-fats (35.3%) and low sugar/sugar free (34.4%) than low salt/salt free (24.6%) or low fat/fat free (26.3%).

8.2.2 Perceptions and awareness of consumers regarding sugar and preferences for interventions

Although the majority of respondents in this study (86.9%) believed that to help the general population to consume less sugar, food manufacturers should add less sugar to food and drinks, just over a third (34.4%) believed that food manufacturers should swap sugar for sweetener in foods and drinks (Table 10).

Table 10: Methods to aid individuals and the general public to consume less sugar ($n=122$)

Interventions to reduce sugar consumption	General public (%)	Yourself (%)
Providing graphic nutritional information of sugar content	51.6	36.1
Providing information on sugar content and better alternatives	77.0	59.8
Providing health warnings regarding the consumption of added sugar	55.7	22.1
Food manufacturers should add less sugar to food and drinks	86.9	63.1
Food manufacturers should swap sugar for sweetener in foods and drinks	34.4	16.4
The Welsh Government should provide information on how individuals can reduce the amount of sugar they eat	59.8	31.1
The Welsh Government should introduce a tax on sugary drinks	57.4	31.1
Diet and sugar-free alternatives should be cheaper	52.5	35.2

It was also determined that between a half and three-quarters of consumers believed that providing imagery information on sugary drinks would aid consumers to consume

less sugar. The preferred methods were providing information on sugar content and better alternatives indicating that diet alternatives contain no sugar (77.0%). More than half of respondents also indicated they believed that a tax on sugar-sweetened drinks (57.4%) and cheaper diet and sugar-free alternatives (52.5%) would aid the general public to reduce sugar consumption.

The majority of respondents (86.9%) reported that they did something to reduce, limit or monitor the amount of sugar they consume. Responses included:

"I eat less sugary foods than I used to e.g.: cakes and biscuits and try and drink mainly tap water"
"I do not use refined sugar opting for honey or maple syrup I also limit treats containing"
"I make sure it's never more than 50g a day by looking at ingredient lists and cutting back on chocolate... Which was hard because chocolate is amazing."
"Yes, I'm not stupid so I know what I'm eating and what the consequences are."
"I have consciously cut down on the amount of sweet things I eat because I have an intolerance to sugar. I think it's disgusting the amount of sugar that is in almost 100% of food available to people. The only way to cut down on sugar is to eat and cook fresh."

Qualitative responses have been categorised in Table 11. The reported practices to reduce sugar consumption included buying diet, unsweetened and/or sugar free food products (20%), cooking from scratch (19.2%), and avoiding processed foods (18.3%). However, with more reporting the use of honey and 'natural' sources of sweetness, such as agave, carob and maple syrups (5.8%) than the use of calorie free sweetener (3.8%), this may suggest that consumers perceive 'natural' sugars to be healthier than artificial sweeteners, although 'natural' sugars contain calories similar to sugar (see Table 11).

Table 11: Categorised reported practices to reduce, limit or monitor the amount of sugar consumed (n=104)

Practices	%
Buying diet, unsweetened and/or sugar free food products	20.2
Cook from scratch	19.2
Avoid processed foods	18.3
Eat less sugary foods	12.5
Avoid sugary drinks and fruit juices	10.6
Read labels/check ingredients	9.6
Don't add sugar to foods/drinks	9.6
Consume in moderation	5.8
Use honey and 'natural' sources of sweetness (agave, carob and maple syrups)	5.8
Avoid sugar	4.8
Watch intake	4.8
Nutrition/diet app	3.8
Use calorie-free/low calorie 'artificial' sweetener	3.8
Self-control/conscious eater	1.9
Diabetes	1.0

8.2.3 Perceptions and awareness of consumers regarding salt and preferences for interventions

With regards to aiding a reduction in salt consumption, the majority of respondents believed that manufacturing more food products made with low-sodium salt or salt alternatives would enable the general population (68.9%) and themselves (46.7%) to consume less salt along with the provision of information from the Welsh Government on how individuals can reduce the amount of salt consumed (see Table 12).

Table 12: Methods to aid individuals and the general public to consume less salt (n=122)

Interventions to reduce salt consumption	General public (%)	Yourself (%)
Ban the availability of salt as a seasoning commodity in cafes and restaurants	24.6	14.8
Providing information on salt reduction and removing salt shakers/sachets from tables in cafes and restaurants	45.9	20.5
Ban restaurants, cafes and takeaways from adding salt to food products	45.9	30.3
Food manufacturers should make more food products made with low-sodium salt or salt alternatives	68.9	46.7
The Welsh Government should provide information on how individuals can reduce the amount of salt they eat	65.6	41.8

Seventy-one per cent of respondents indicated that they do something to reduce, limit or monitor the amount of salt that they eat. Just under a third (31%) reported they do not add salt to food when cooking or eating:

“Don't put salt on the dinner table and use less salt in cooking.”

Although some indicated awareness, over a quarter (26.4%) believed they consumed salt in moderation and were able to control how much they add or only added salt when they thought necessary:

“General awareness of salt levels in my diet and rarely cook with salt, just add when serving a meal”

Around a fifth of respondents (19.5%) reported that they avoid or limit their consumption of processed foods to reduce the amount of salt consumed and 13.8% reported that they cook from scratch using fresh food products to control the amount of salt consumed.

As indicated in Table 13, reported use of low-salt or alternatives such as pepper and herbs was low. However, some believed that the use of unrefined salts reduced the amount of salt they consumed.

Table 13: Categorised reported practices to reduce, limit or monitor the amount of salt consumed (n=87)

Practices	%
Don't add salt when cooking and/or eating	31.0
Consume in moderation, control what is added when necessary	26.4
Avoid/limit processed foods	19.5
Cook from scratch / use fresh products	13.8
Look at labels on food products	6.9
Buy reduced salt products	3.4
Use low salt	2.3
Use unrefined salts	2.3
Use pepper and herbs instead of salt	1.1
Use a telephone health app	1.1

Additionally, with regards to salt, one respondent stated:

“I believe this to be a false health issue”

8.2.4 Perceptions and awareness of consumers regarding fat and preferences for interventions (SCQ findings)

The study determined that the majority of respondents believed that having 'air fried' alternatives of traditionally deep-fat fried food products available in restaurants, cafes and canteens, (the use of 'hot air fryers' result in food products with 80% less fat) would enable themselves (50.8%) and the general public (72.1%) to reduce the amount of fat consumed. Similarly, more than half (52.5 – 67.2%) believed that all

suggestions would enable themselves and the general population to consume less fat (Table 14).

Table 14: Methods to aid individuals and the general public to consume less fat (n=122)

Interventions to reduce fat consumption	General public (%)	Yourself (%)
Ban the availability of deep fat fried food products in work place canteens	52.5	14.8
Make 'air fried' alternatives of traditionally deep fat fried food products available in restaurants, cafes and canteens (use of 'hot air fryers' result in food products with 80% less fat)	72.1	50.8
Food manufacturers should make more low-fat and fat-free food products available to give people the choice	67.2	45.1
Cafes, restaurants and workplace canteens should use low calorie spray in place of fat/oil/butter when shallow frying.	58.2	36.1
The Welsh Government should provide information on how individuals can reduce the amount of fat they eat	63.9	36.1

Three-quarters of participants (75.4%) reported that they do something to reduce, limit or monitor the amount of fat they consume. The majority of which indicated that processed foods would be avoided or limited (18.5%) and that cooking methods had been changed (18.5%). These included swapping to air-frying, dry frying, grilling and poaching and using low calorie spray oils. Around a tenth indicated that they avoid deep fat fried food products, purchase fat free or low fat products such as yoghurt and skimmed milk, and use oils believed to be 'healthier' including nut, coconut, avocado, olive and sunflower (13.0 – 14.0%). Fewer indicated that lean cuts of meat would be selected or that excess fat would be removed (9.8%) and that labels would be assessed (6.5%) (See

Table 15).

Variations in the use of alternatives were determined, with some indicating concerns regarding low fat alternatives and using full fat foods in moderation:

“Be aware, consume in moderation, and don’t eat ‘alternatives’ just lessen real fat.”

“I often choose a low fat alternative - although I am now aware that the replacements can be as harmful.”

“I choose low fat alternatives if I don’t feel that this compromises taste, but go for full fat natural versions rather than manufactured fats (i.e. margarine) in moderate quantities. Use olive oil & vegetable oil in cooking, but in small amounts.”

Table 15: Categorised reported practices to reduce, limit or monitor the amount of fat consumed (n=92)

Practices	%
Avoid/limit processed foods (including takeaways and pastry food)	18.5
Change methods (air fry/dry fry/grill/poach) including use of spray oils/low calorie sprays	18.5
Do not eat deep fat fried foods	14.1
Buy low fat/ fat free/ skimmed milk	13.0
Use 'healthier' oils (including nut, coconut, avocado, olive, sunflower)	13.0
Cook from scratch using fresh food products	10.9
Remove/trim fat from meats or select lean meats/cuts	9.8
Look at food product labelling and ingredients	6.5
Moderation	4.3
Follow Weight-Watchers / Slimming World / food plan / low-fat diet regime	4.3
Generally aware/conscious	4.3
Phone app	2.2
Vegetarian diet	1.1
Use less fat when cooking	1.1

A set of questions was devised to determine the desirability and consumption of regular and reduced fat biscuits.

- A strong positive correlation was determined between the reported desirability of a regular biscuit and the number of biscuits that would typically be consumed. Greater desirability was associated with greater consumption ($r = 0.51$, $n = 109$, $p < 0.001$).
- Similarly, with a reduced fat version of the same biscuit, a medium positive correlation was determined between the reported desirability of the biscuit and the number of biscuits that would typically be consumed, with greater desirability associated with greater consumption ($r = 0.46$, $n = 98$, $p < 0.001$).
- A significant difference was determined in desirability between regular ($M = 5.4$, $SD = 2.64$) and reduced fat biscuits ($M = 4.8$, $SD = 2.96$), $t(104) = 2.34$, $p < 0.05$. It was established that the desirability of the reduced fat version was significantly lower than the regular biscuit.
- No significant difference was determined in consumption between regular and reduced fat biscuits ($p > 0.05$).

Although the reduced fat product becomes less desirable, consumers indicate that consumption will not be reduced, suggesting the need for food product reformulation to reduce calorific intake. It may also be argued that covert reformulation should take

place to regular products to reduce fat content, as consumers perceive food products that are declared as ‘reduced fat alternatives’ to be less desirable. Findings may also suggest that consumers need to be educated to consume fewer of the “desirable” food products.

8.2.5 Trans-fat

The majority of respondents (63.6%) reported that they were aware of what trans-fats were. Just under a quarter were aware that these fats have been processed (24.7%) and had been hydrogenated (23.4%). Seventeen percent used ‘bad’ and/or ‘dangerous’ to describe trans-fats (See Table 16).

Table 16: Words used to describe trans-fats (n=121)

Words used to describe trans-fats	%
Engineered/processed/manufactured/treated/changed	24.7
Hydrogenated / hydrogen added	23.4
Bad / dangerous	16.9
Artificial	14.3
Unhealthy	3.9
Unnatural	2.6
Unsaturated	2.6
In processed foods	2.6
Body can't process	2.6
Unstable	1.3
Genetically modified	1.3

The belief of respondents regarding the UK’s position about trans-fats was determined (see Table 17) with the greatest proportion (49.6%) believing that trans-fats should be banned from foods and 28.9% believing that trans-fats could be included in food products but that they should appear on the label. One respondent believed that trans-fats should not be labelled.

Table 17: Belief what the UK’s position about trans-fats should be (n=121)

Beliefs regarding trans-fats	%
Continue with our current position, trans-fats can be included in foods and are not labelled	0.8
Trans-fats can be included in foods but should appear on the label (the same as in Canada)	28.9
Trans-fats should be banned from foods (the same as in Switzerland)	49.6

8.2.6 Healthy eating

The majority of respondents believed that interventions when eating out would be most beneficial to helping healthy eating. The inclusion of traffic light labelling on menus in restaurants, cafes and canteens (49.2%) along with the inclusion of calorie content on menus (48.4%) would help themselves to eat more healthily, whereas, the inclusion of the calorie content of alcoholic drinks on labels was believed would help the general public (72.1%) to consume more healthily. Easier access to weight-loss solutions, such as healthy eating support groups (e.g. Weight Watchers and Slimming World) was determined to be the least beneficial.

Table 18: Interventions to aid healthy eating (n=122)

Interventions to aid healthy eating	General public (%)	Yourself (%)
Inclusion of traffic light labelling on menus in restaurants, cafes and canteens	71.3	49.2
Inclusion of calorie content on menus in restaurants, cafes and canteens	61.5	48.4
Including the calorie content of alcoholic drinks on labels	72.1	46.7
Legal requirement to include healthier options on menus in restaurant, cafes and canteens	60.7	45.1
Introduction of healthy vending machines with fruit choices	59	34.4
Food manufacturer reduction in portion sizes	61.5	33.6
Ban on high fat and high sugar food product advertisements on television before 9pm	63.9	28.7
Easier access to weight-loss solutions	51.6	26.2

It was established that when eating out in a cafe, pub or restaurant, respondents indicated that they would find it helpful to see nutritional information on the menu such as calorie contents (55.7%) or icons to identify healthier dishes (50%) (See Table 19).

Table 19: Nutritional information that would be helpful when eating out (n=122)

Nutritional information that would be helpful when eating out	%
How many calories each dish contains	55.7
A general healthy logo on healthy dishes	50.0
A reduced sugar logo on reduced sugar dishes	50.0
Traffic light labelling	49.2
A reduced fat logo on reduced fat dishes	46.7
How many calories alcoholic drinks contain	45.9
A reduced salt logo on reduced salt dishes	45.1

The majority (89.3%) reported that they do something to ensure a healthy diet. Analysis of responses determined that the greatest proportion (35.8%) believed that cooking from scratch with fresh food products ensured a healthy diet, just over a quarter referred to consuming fruits and vegetables (28.3%) and limiting processed

food products (26.4%). Fewer indicated that schemes such as the eat-well plate, traffic light food labelling and calorie content labelling were utilised to ensure a healthy diet.

Comments included:

“I try and watch what I eat but I am not very successful at it. I know what is healthy but prefer what is not!”

“I try to eat real food, better and less. I don't touch anything that's 'fake' e.g. where salt sugar or fat has been replaced by over-processing or artificial ingredients.”

Table 20: Unprompted reported practices to ensure healthy eating (n=106)

Practices	%
Cook from scratch	35.8
5 a day / fruit and vegetables	28.3
Limit/avoid processed foods	26.4
Eat less/healthy eating plan/meal plans/balanced diet	17.9
Avoid/limit sugar and sugary foods/drinks	11.3
Eat sensibly/moderation/occasional indulgence	7.5
Exercise	6.6
Avoid refined carbs/high carb foods and bread	5.7
Varied diet/wide range of different foods	5.7
Limit red meat	5.7
Vegetarian/vegan diet	5.7
Look at traffic lights / calorie labelling	4.7
Avoid fried and fatty foods /eat low fat foods	4.7
Eat wholemeal/wholegrains	3.8
Eat less salt	3.8
Diet app/online support	2.8
Follow eat well plate	1.9
Count calories	1.9
Eat high protein	1.9
Limit dairy	1.9
Limit/avoid alcohol consumption	1.9

8.2.7 Front-of-pack traffic light nutritional information

When prompted, the majority of participants (75.4%) reported that they would ‘always’ – ‘sometimes’ take notice of front-of-pack traffic light nutritional information.

Table 21: Self-reported frequency of taking notice of front-of-pack traffic light nutritional information when shopping for food (n=118)

Frequency	%
Always	18.6
Most of the Time	24.6
Sometimes	32.2
Rarely	14.4
Never	9.3
Don't know	0.8

Although many reported taking notice of traffic light labelling, knowledge of criteria for food to be classed as low and high was lacking with 75.4 – 84.4% stating ‘don’t know’ as responses. Findings indicate that only a small proportion (<4.1%) of respondents were aware of nutritional limits (see Table 22).

Table 22: Knowledge of traffic light nutritional labelling classifications (n=122)

	‘Low’ classification / green category			‘High’ classification / red category		
	Correct (%)	Incorrect (%)	Don’t know (%)	Correct (%)	Incorrect (%)	Don’t know (%)
Fat	1.6	23.0	75.4	3.3	15.6	81.1
Saturates	3.3	14.8	82.0	0.8	18.9	80.3
(Total) Sugars	2.5	14.8	82.8	0.0	17.2	82.8
Salt	4.1	13.1	82.8	1.6	13.9	84.4

Awareness of the categories that specific food products would be classified under for content of sugar, salt and fat was greater. Between 29.2% and 57.5% selected the correct categories for nutritional content, as indicated in Table 23.

Table 23: Awareness of food product traffic light classifications (n=113)

Food products	Red category (%)	Amber category (%)	Green category (%)	Don't know (%)	Correct response
Sugar in custard tarts (6g sugar per 100g)	26.5	57.5	8.0	8.0	Amber 57.5%
Salt in cornflakes (1.1g salt per 100g)	9.7	54.0	27.4	8.8	Amber 54.0%
Total fat in ginger nut biscuits (16g total fat per 100g)	57.5	29.2	4.4	8.8	Amber 29.2%
Saturated fat in standard potato crisps (2.5g saturated fat per 100g)	45.1	41.6	4.4	8.8	Amber 41.6%

8.2.8 Interventions to impact on health

Public health interventions believed to have or would have the greatest impact to enable the general public to eat healthier, included the availability of healthier options

on menus when eating out (48.1%) and the use of front-of-pack traffic light nutritional labelling on food products purchased from supermarkets (45.4%) (see Table 24). Greatest variation was determined in the perceived impact of a tax on sugar-sweetened drinks, (which would result in a 20% increased cost compared to non-diet drinks), with nearly half (47.7%) believing it would have greatest impact on health, but nearly a quarter (23.4%) believing it would have a minimal impact on health. Access to weight-loss support groups such as Slimming World and Weight Watchers (30.4%) and a ban on high fat and high sugar food product advertisements on television before 9pm (25.0%) were the interventions that were perceived to have the lowest impact.

Table 24: Perceived impact of interventions to enable the general public to eat healthier

Interventions (1: Maximum impact - 10: No impact)	n	Mean	Std dev	Ranked 1-3 (%)	Ranked 8-10 (%)
Inclusion of healthier options on menus when eating out	106	4.1	2.5	48.1	11.3
Front-of-pack traffic light nutritional labelling on food products purchased from supermarkets	108	4.1	2.3	45.4	10.2
The inclusion of calorie content on alcoholic drinks labels	106	4.5	2.7	42.5	17.0
Tax on sugary drinks (+20% increased cost on non-diet drinks)	107	4.6	3.2	47.7	23.4
Inclusion of traffic light labelling on menus when eating out	106	4.8	2.5	35.8	15.1
Inclusion of calorie content on menus when eating out	107	4.9	2.5	30.8	15.0
Reduction in pre-packed food product portion sizes	105	4.9	2.6	33.3	15.2
Ban on high fat and high sugar food product advertisements on television before 9pm	104	5.2	3.0	31.7	25.0
Healthy vending machines with fruit choices	103	5.5	2.6	22.3	15.2
Access to weight-loss support groups (e.g. Slimming World and Weight Watchers)	102	5.8	2.8	24.5	30.4

The perceived responsibility of food health, nutrition and health was greatest for ‘self’, with the vast majority (87.4%) of respondents believing themselves to have total or near total responsibility, the responsibility of food manufacturers was also near total by the majority (73.2%), whereas only three-fifths (60.4%) perceived the Government to have greatest levels of responsibility (See Table 25). Although consumers are aware of the shared responsibility for food, nutrition and health, their own personal responsibility is not underestimated, findings indicate that consumers are aware that they are personally responsible.

Table 25: Perceived responsibility for food, nutrition and health

Responsibility (1: No responsibility - 10: Total responsibility)	n	Mean	Std dev	Ranked 1-3 (%)	Ranked 8-10 (%)
Yourself	111	8.9	1.6	0.9	87.4
Food manufacturers	112	8.2	2.0	3.6	73.2
The general public	112	8.2	1.9	2.7	71.7
Drink producers	111	8.1	2.0	3.6	71.2
Supermarkets	111	7.8	2.1	3.6	65.8
Workplace canteens	111	7.6	2.1	5.4	58.6
Cafes and restaurants	111	7.2	2.1	6.3	45.9
Government	111	7.5	2.4	7.2	60.4

8.2.9 Consumer attitudes towards food industry reformulation

Respondents gave their thoughts about the food industry reformulating food products to create products with reduced or low- salt, fat or sugar content, and using replacements for salt, fat and sugar. Many respondents indicated that they believed reformulation to be a good idea:

"If we know these substances are bad for our health, I think that it is essential this happens."

"One way of reducing the risks"

"Judging the amount of obesity in Wales, the food industry need to take more responsibility in the products they sell. It seems that the general public take no responsibility at all in what they put in their mouths, therefore help is required to control the eating habits of the public who can't/won't help themselves."

"Fine if not at the expense of quality, taste or price."

Although some had positive attitudes towards reformulation, some indicated a specific preference for the reduction of sugar and salt but not fat:

"Reduce the sugar yes good idea. The fat is ok."

"Reduced salt and sugar products are a good idea. Reduced fat products should not come at the expense of increased sugar content, as is the case now (low fat yoghurts etc. can be really high in sugar). Indications of levels of saturated fats should be a priority. Also more clarity about the presence of MSG, preservatives and sweeteners in food."

"Reduced salt and sugar should be good. It will change people's tastes. I'm not sure about fats; I understand that natural, animal fats are better for you than reduced fat products."

"Where products are low fat they tend to use sugar to enhance the flavours & where sugar free they add synthetic sugars which can also cause high blood sugars."

The potential of covert reformulation was also brought up:

"For those who will always buy say ready meals and sauces in jars I think this (reformulation) is a good idea on the whole. People may not even realise they're buying a new healthier product so for many this could be a good solution."

However, some respondents expressed concerns regarding alternatives used in reformulated food products:

"In theory a good idea as long as the substitutes are genuinely better and don't just swap one bad thing for another."

"I personally don't feel that natural foods are unhealthy, I always eat butter, don't touch artificially made margarine for example."

"I believe all additives and preservatives are what's harmful."

"I really dislike artificial sweeteners and salt substitutes!"

"I know some people don't like artificial sweeteners, but I like them because it's no calories. I like the idea of less calorie foods but only if they taste good. Bad food is ok is only eaten as a treat"

"The replacements use chemicals which can potentially have a greater impact on the body than the naturally occurring salt, fat and sugar."

Along with health concerns, consumers indicated a concern regarding the potential costs involved with reformulation:

"The replacements use chemicals which will cost more to produce which will be passed on to the consumer"

Others disagreed with reformulation, and believed the answer was consumer based nutrition education and allowing the consumer to make informed decisions:

"I don't agree with this at all. People should've encouraged to learn about real food, how to cook, how to eat a balanced diet using real foods. NOT by creating overly processed foods that taste the same as high sugar high fat etc. I believe everyone should feel fine about eating high fat high sugar foods as long as in absolute moderation. E.g. a slice of a mars bar, not a whole one. One sausage, not three. And made without chemicals, substitutes, bulking agents, sodium replaces. Eat better, eat less, but eat what you want. And learn to taste food better, not to crave sweet or salty foods even if they are substitutes- that's just encouraging a taste for sweet fat and salt but making it 'OK' to do so."

"This would be helpful, however reducing fat/sugar/salt can often compromise taste - customers should be offered a clear choice but not forced into particular options. People should have the option to choose "unhealthy" food once in a while as a treat, though the packaging & labelling should make it clear that these foods should only be considered as an occasional treat by highlighting that they are not particularly healthy."

"Clear, well-informed messages by government and manufacturers would help educate."

"So much depends upon people being willing to cook and prepare their own food from basic ingredients, and I think this kind of education and encouragement is really crucial in helping people move towards a healthy diet."

Whilst others discussed the role of exercise in addition to healthy diet:

"I am also a big believer that we need to push sport more within this country. We are a lazy nation. Nowhere near enough money is put into sport for kids... It is just not affordable for the low-income parents. It is quite sad really, that people on lower incomes feel that their only option is to buy cheap/processed/unhealthy foods and are also not able to afford to send their children to sporting clubs. They are left in the position of having a poor diet with limited access to sporting activities - both of which have led to the rise in child hood obesity. It has been obvious for years and it's about time something was done about it rather than politicians talking about it."

The role of the food industry in consumer health and nutrition and in the reformulation of food products was discussed:

"Profits seem more important than health to UK food industry."

"I really don't think that the huge companies are interested....only legislation or customers voting with not purchasing items will do anything."

"Cost of production will be too big and most of producers won't do it"

"However, the food industry should not over sweeten, over salt etc. and should be more responsible. The producers are too far removed from the consciousness of the consumer when purchasing foods in a supermarket."

"The food industry is a business designed to get people hooked on sugary, salty and fatty processed food so they can squeeze as much profit out of the public as possible. They have a responsibility and accountability to be honest especially in case of children and low income families when they are promoting cheaper, healthier foods to vulnerable consumers. Fresh produce should be

cheaper. It'll lead to a healthier, fitter and more productive nation and less strain on the NHS. Tax the food producers who make this unhealthy rubbish processed food. Educate children in schools, provide healthy food for school lunches and hospital meals."

"You can't just blame them (the food industry). There is so much information around but people are lazy and take the easiest option."

8.2.10 Role of the Welsh Government in improving food-related health

The role of the Welsh Government in aiding the general public to improve their food-related health was discussed by many respondents. Comments included recommendations for food-related health education, discussions relating to education considered portion size, cooking skills, food procurement and where food comes from. Although some indicated a desire for literature, others did not:

"Much of Wales' obesity problem starts in the early years which is totally the responsibility of parents. They need better educating. I believe it's also linked to the high rates of poverty in Wales as well. Healthy food should be cheaper than fat, convenience foods. Publication of cheap, healthy recipes and marketing campaigns with influential sports personalities may also help."

"Consumers need to change their eating behaviour and usually buy brands that have been advertised. Manufacturers and advertisers along with government food regulators have to rethink and control ingredients that harm our health causing obesity, arthritis and diabetes. NHS would benefit too with a healthier nation. Eyes are bigger than our bellies and in time the nation could get used to less sugar, salt and fat. Bring it on please ASAP. A gradual process change to levels of sugar preferably so the body adapts and not goes into shock. This survey is most definitely essential and thank you."

"Make a user friendly website which has sections for everyone's dietary needs (religious, vegetarian, maybe even nutrition advice for people who gym a lot) which helps them find info about what they are eating, what affect it has on their body and diet tip. Other than this, it's the individual's responsibility to eat healthy, and tax payers' money of people that do eat healthy shouldn't be wasted on those that don't."

"More food, weight and health clinics on the NHS open to all. Better to spend on prevention rather than the expense of treating problems."

"More educational information sources and initiatives that people can get involved in. Pop up stands/shows of free fresh fruit and veg in public places/events. Be more explicit in the health initiatives and really hit home to people that we should all be a bit more thinner."

"Perhaps use shock tactics in short information films showing what happens when taking too much salt/sugar/fat. Emphasising the impact it has on the economy regarding treatment for diabetes and other eating disorders created through overeating and obesity."

"Promote the Healthy Options Scheme run by a few councils. Ban sale of fizzy drinks in schools etc. Weight watchers or similar groups on prescription for overweight people. Requiring GPs to tell people they are overweight and address the issue with them. Definitely not more health promotion! We've been leaflets D and lectured to the point no one listens."

"To be a healthier nation we need to be taught and encouraged more to eat a balanced diet and exercise more. I know exactly what I should and should not eat but I just cannot stick to a diet - more time and money should be invested in helping people 'stick' to things. It's very easy to encourage and start new initiatives - it's the keeping to it that's the challenge. Free diet classes would be good or a mentoring system where you get a weight loss buddie. Weekly weighing does help."

"Portion control. No one explains what a healthy portion is."

It was also suggested that the Government should lead by example:

"Lead by example - get overweight government and council workers fit and healthy and on weight loss programmes."

Some respondents highlighted the need of the Government to address the responsibility of individuals in food-related health and particularly, the responsibility of parents in relation to childhood obesity:

“Welsh Gov can run awareness campaigns but this relies on people taking responsibility for their own health and eating habits. The sad reality is that people are lazy and want cheap food, so it comes back to manufacturers and supermarkets.”

“People need to take responsibility. Government has a role but they're not to blame.”

“We are responsible for our own health, I don't think that people would listen to the government”

“Parents of children that become obese due to diet should be treated in the same way that parents who mistreat children are treated.”

“Jail parents of obese children, stop letting kids buy energy drinks.”

Other actions that the Welsh Government can take to improve food-related health included, taxation of ‘unhealthy’ food products and cheaper availability of ‘health’ food:

“Insist that food manufacturers make the healthiest version of their foods possible. Tax high sugar foods and drinks. Label alcoholic products.”

“Enforce manufacturers suppliers etc. everyone to push for ready-made food to be healthier and to make fresh good quality food prices affordable.”

“Give me money to buy healthier food.”

“Greater access to healthy options. Cheaper prices for healthy food.”

“The Welsh Government should get its act together, introduce in future very high taxes on junk food in future and highly regulate the takeaway industry. In addition establish a powerful health eating initiative across all sectors in Wales and investing in local primary and secondary healthy food production businesses. Draconian maybe, but what's the alternative, generations of chronic obesity and huge health deficit to deal with.”

“PopTax!”

However, some did not feel that it was the responsibility of the government:

“I personally believe that it isn't down to the Government. It is a personal choice of the individual, and people need to take more responsibility for what they eat. The only thing the government can do is help keep the cost of healthy food down.”

“Keep your noses out- over-regulation of the food industry will ultimately raise inflation and not impact on health as people will eat and drink unto satiation if they are so minded.”

8.3 Summary of findings

Consumer based research was conducted to determine the attitudes of consumers in Wales regarding nutritional education interventions and reformulated food products. Obtaining an understanding of the perceived impact and effect of interventions to enable consumers in Wales to reduce the amount of fat, salt and sugar they consume, is essential to enable the development of future policy and nutritional educational interventions.

8.3.1 Self-reported practices

The majority of respondents self-reported to do something to reduce, limit or monitor consumption of target nutrients, with a greater percentage reporting to do so for the amount of sugar (87%) consumed compared with fat (75%) and salt (71%). This may be as a result of recent campaigns to reduce sugar consumption and the ‘demonization’ of sugar by the media. Self-reported practices relating to reducing, limiting or monitoring consumption of fat, salt and sugar included buying ‘diet’ and sugar-free food products, not adding salt when cooking or eating, cooking from scratch, avoiding processed foods, changing cooking methods or using low calorie sprays.

8.3.2 Perceptions of nutrition interventions

For all potential actions to reduce consumption of fat, salt and sugar, respondents perceived actions would be more beneficial to the general public than to themselves. This may indicate that any interventions or educational strategies to improve consumer food-related health may be overlooked by consumers as they perceive the interventions to be intended for ‘others’ and not themselves. Future interventions need to address consumer perceptions of risk, control and responsibility for nutrition.

Cumulatively, for all target nutrients, food manufacturers adding less sugar to food and drinks and providing visual information on food products and drinks regarding sugar content and better alternatives, were the action believed to have the greatest impact on themselves and the general public to aid a more nutritious diet. Other potential actions included ‘Food manufactures should make more food products made with low-sodium salt or salt alternatives’ and ‘make ‘air fried’ alternatives of traditionally deep fat fried food products available in restaurants, cafes and canteens’.

Around half of respondents indicated that including nutritional information, such as traffic light labelling and/or calorie contents, when eating out of home were the most beneficial actions.

The actions identified as having the greatest potential impact to enable the general public to eat healthier included the availability of healthier options on menus when eating out, FOP traffic light nutritional information on food products in supermarkets. The inclusion of calorie content on alcoholic drinks labels and a 20% tax on sugar-sweetened were also identified as potentially having the greatest impact on health.

Although the majority indicated taking notice of front-of-pack traffic light nutritional information, only a small proportion were aware of nutritional category limits. However, between 29-58% were able to identify the correct categories when nutrient information was provided.

8.3.3 Role of the Welsh Government

Although some consumers did not believe that the Welsh Government were responsible for aiding the general public to improve their food-related health, some indicated a desire for food nutritional information and education through resources such as literature, websites, health clinics. Monetary issues were referred to, indicating that 'healthier' food products should be cheaper and more readily available and that 'unhealthy' food products such as sugar-sweetened drinks should be taxed. Discussions regarding the role of the Welsh Government also related to the need for government to address the responsibility of individuals. Points raised by participants also referred to the responsibility of overweight and obese children.

8.3.4 Perceptions of risk, control and responsibility

The method of measuring consumer perceptions of risk, control and responsibility are most commonly applied in the field of food safety. However, it has been successfully implemented in this study. Findings from this study determined that, although trans-fat and saturated fat were perceived to have the greatest risk, total fat was perceived to have the lowest level of risk to health. This may indicate an underestimation in the perceived risk of fat, known as 'optimistic-bias'. In addition, respondents perceived themselves to have marginally greater levels of control for the amount of fat they consume, compared to sugar and salt. This may indicate the 'illusion of control'.

Consequently, it can be suggested that consumer-orientated interventions need to address perceptions of risk and the notions of 'optimistic-bias' and the 'illusion of control'. Failure to do so may render nutritional education communication initiatives ineffective and thus, hinder efforts to change consumer food consumption behaviour

The lowest perceived responsibility was for trans-fat. Although around two-thirds were aware of personal responsibility for consumption of fat, salt and sugar, recognition of personal responsibility for nutrition is considered to be a prerequisite for the implementation of appropriate risk-reducing behaviour. Failure to assume

responsibility may result in an increased potential for behaviour that is not beneficial to health. Indeed, findings from this study determined that although respondents considered external providers of food (food establishments, government, food producers and retailers) to be accountable for food health and nutrition, indicating a belief of shared responsibility, personal responsibility was not underestimated, with the vast majority perceiving themselves to have the greatest levels of responsibility. Strong positive correlations were determined between perceived control and responsibility for all nutrients, with high levels of responsibility associated with high levels of perceived control.

These findings from consumers in Wales are essential for consideration in the development of future health behaviour interventions such as targeted nutritional information.

BWYD A DIOD CYMRU
FOOD AND DRINK WALES



www.gov.wales/foodanddrinkwales

bwyd-food@wales.gsi.gov.uk

 @FoodDrinkWales