Routledge
Taylor & Francis Group

Journal of Foodservice Business Research

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/wfbr20

# Simple ways to improve nutrient content and health profile in different types of foodservice products

**Terhi Junkkari, Anu Hopia, Maija Paakki, Saila Mattila, Leena Arjanne, Maija Kantola & Harri Luomala**

**To cite this article:** Terhi Junkkari, Anu Hopia, Maija Paakki, Saila Mattila, Leena Arjanne, Maija Kantola & Harri Luomala (30 Dec 2023): Simple ways to improve nutrient content and health profile in different types of foodservice products, Journal of Foodservice Business Research, DOI: 10.1080/15378020.2023.2298626

**To link to this article:** https://doi.org/10.1080/15378020.2023.2298626



Published online: 30 Dec 2023.

JOURNAL OF FOODSERVICE BUSINESS RESEARCH
https://doi.org/10.1080/15378020.2023.2298626

Routledge
Taylor & Francis Group



# Simple ways to improve nutrient content and health profile in different types of foodservice products

Terhi Junkkari[a,b], Anu Hopia[b], Maija Paakki[b], Saila Mattila[b], Leena Arjanne[a], Maija Kantola[c], and Harri Luomala[c]

[a]Technology and Business, Food and Hospitality, Seinäjoki University of Applied Sciences, Seinäjoki, Finland; [b]Functional Foods Forum, University of Turku, Turku, Finland; [c]School of Marketing and Communication, University of Vaasa, Vaasa, Finland

**ABSTRACT**

This study shows how two foodservice products, French fries with sausage (representing vice food) and vegetable and lentil soup (representing virtue food), can be reformulated to meet the nutritional recommendations without compromising consumer acceptance. The reformulation process involved recipe development and testing, including techniques such as salt reduction, fat quality modifications, and spicing solutions to compensate the flavor changes. The reformulated products were evaluated by both consumers ($N = 123$) and sensory professionals ($N = 9$). Consumer testing revealed no significant differences in overall pleasantness between the original and the reformulated products. However, the reformulated versions received higher ratings for smell and pleasantness of appearance. This suggests that it is possible to reformulate products with conventional nutrient profiles without negatively affecting consumer acceptance. The sensory professionals also evaluated the reformulated products similarly. The nutrient content of both products significantly improved following reformulation. The study concludes by recommending the widespread implementation of reformulation techniques in the foodservice industry. Authorities are encouraged to support this by providing funding for training in recipe modification techniques. In addition, closer cooperation and knowledge sharing among stakeholders in the food supply chain are recommended to further enhance the implementation of reformulation practices.

**KEYWORDS**

Reformulation; flavor profile; foodservice; recipe modification

## Introduction

Unhealthy eating increases the risk of several lifestyle diseases, and thus has a significant impact on society's healthcare costs. Authorities have demanded the reformulating of foods to better meet the nutritional recommendations as part of their long-term policy (Council of the European Union, 2016; EU, 2016; Institute of Medicine, 2010; WHO, 2018; WHO European Region, 2021a). Since the

**CONTACT** Terhi Junkkari terhi.junkkari@seamk.fi Technology and Business, Food and Hospitality, Seinäjoki University of Applied Sciences, FI-60101 Seinäjoki, Finland

beginning of the 21st century, various national implementation policies, including both voluntary commitments and mandatory limits for nutrient composition, have been in place to make average diets significantly healthier in many countries (WHO, 2018). Because of these activities, average diets have become significantly healthier in many countries during the last few decades, but many people's diets still contain too much sugar, salt, and saturated fat, and less dietary fiber than recommended (Eilander et al., 2015; Shan et al., 2019; WHO, 2018).

In recent years, policymakers have increasingly demanded more actions to make the supply of foods and the dining environment healthier (U.S. Government Accountability Office, 2022; WHO, 2018). The food industry has been extensively reformulating its products since the beginning of the 21st century (Buttriss, 2013; Harastani et al., 2020; Outila et al., 2006). Consequently, in our research, we address two pertinent research gaps. Less attention has been given to 1) reformulation in the foodservice sector, even though out-of-home (OOH) eating has increased significantly in recent years, and OOH food is generally less healthy than homemade food (Elitzak & Okrent, 2018; Lachat et al., 2012; Vandevijvere et al., 2013; WHO European Region, 2021b); and 2) the impact of health and nutritional information labeling on consumer behavior in the foodservice sector (Byrd & Almanza, 2021; Janssen et al., 2015; Patel et al., 2016; Stewart et al., 2018). As OOH eating has become more common in recent years, total energy, fat, and salt intakes from OOH eating have increased (Guthrie et al., 2018; Rudelt et al., 2014). Especially, the WHO European Region and the United States authorities have expressed their concern about the increase in OOH eating in recent years (Elitzak & Okrent, 2018; WHO European Region, 2021b). The COVID-19 pandemic further accelerated the trend with, among other things, increased opportunities for meal delivery applications (WHO European Region, 2021b).

The reasons behind serving unhealthier food are myriad in the foodservice sector. One common belief among consumers and chefs is that healthy food is unpalatable, and unhealthy food is tasty (Bédard et al., 2020; Briers et al., 2020; Raghunathan et al., 2006; Reichler & Dalton, 1998). The objective of this study is to test whether foodservice products with an unhealthy nutrient profile could be reformulated to meet the criteria of the nutritional recommendations, using basic reformulation techniques and without compromising consumer acceptance. Our aim is to show that common opinions about the unpalatability of reformulated products is just a lay belief that can be remedied with careful recipe development, testing, and implementation.

The rest of our article is structured as follows. To develop our conceptual framework, we first conduct a select literature review on OOH eating and the foodservice sector's reformulation issues, such as challenges with salt reduction. Next, we introduce our methodology consisting of the development of reformulated versions of one "vice" food and one "virtue" food, and collecting data from both ordinary consumers and trained sensory panelists. Subsequently, we report

the results informing how the reformulated products fare in terms of sensory quality, and finally discuss their implications for theory and practice.

## Literature review

### *Out-of-home eating and the foodservice sector's challenges in reformulation*

Generally, OOH eating includes various kinds of food services, both commercial (such as full-service restaurants and fast-food companies, or primarily business-based foodservice), and noncommercial establishments (such as food served in schools and hospitals, usually a secondary support service). The majority of foodservice sales are generated by commercial restaurants (Institute of Medicine, 2010; U.S. Department of Agriculture, 2023). According to the study by Lin and Guthrie (2012), OOH food is generally unhealthier than homemade food, and as measured in the intakes of total energy, fat and salt, food served by commercial restaurants is even unhealthier than food served by noncommercial establishments. In the current situation, authorities are also concerned by the fact that the OOH market is currently less regulated than other food industry operations (WHO European Region, 2021b).

For customers, it is difficult to estimate actual energy, fat, and salt intake without adequate nutritional content or other health impact information (Moran et al., 2017; Pettigrew et al., 2013). Thus, food manufacturers and suppliers play a key role in introducing a healthier diet. To reach health goals, different reformulation techniques must be constantly developed, tested, and implemented. There are a number of challenges in implementing reformulation in the foodservice sector. The main challenges include concerns about the unpalatability of reformulated products, decreased customer satisfaction, and thus the loss of customers following reformulation (Bédard et al., 2020; Briers et al., 2020; Institute of Medicine, 2010; Murray et al., 2015; Stastny et al., 2011). Some manufacturers have experienced product failures in the past when marketing foods with better nutritional quality. Also, staff skills, the capacity of kitchen facilities, the availability of ingredients, and customer desires all play a significant role in the planning of healthier menus (Institute of Medicine, 2010; MacCon Iomaire et al., 2021; Tsui & Morillo, 2016). Still, many restaurant owners and chefs would like to have more information and training to develop and market healthier products (Ma et al., 2014). In addition to the skills of the restaurant staff, there is also insufficient data available on the impacts of health and nutritional information labeling on consumer behavior in the foodservice sector (Byrd & Almanza, 2021; Janssen et al., 2015; Patel et al., 2016; Stewart et al., 2018). Earlier studies have shown that health labels and nutritional information lead customers toward healthier menu items, smaller portions, and lower calorie intake in foodservice establishments (Freedman & Larner, 2011; Parikh & Behnke, 2015; Sharma et al., 2011). Our study is based on the claim that, currently, the

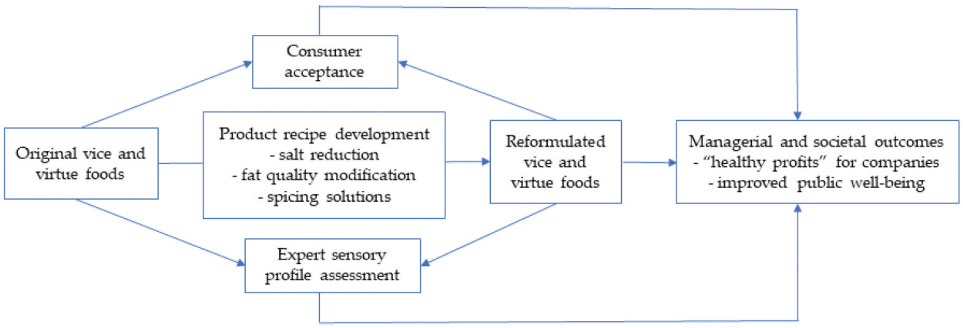


**Figure 1.** Conceptual framework of the study.

implementation of reformulation techniques is not at a sufficient level in the foodservice sector. Our goal is to enhance the implementation of basic reformulation techniques in the foodservice sector without compromising taste and consumer acceptance. A conceptual model of this study is presented in Figure 1.

### *Complexity of salt reduction in reformulation*

The reformulation of foods toward a lower salt content is challenging as consumers do not readily accept changes in the sensory profiles of products. This is because of consumer preferences for a salty taste, but also because salt has effects on the overall sensory profile of foods. In addition, taste perceptions are not only caused by choices of raw materials and cooking techniques, but also by mixtures of food texture and odor-taste interactions (Earle et al., 2017; Hoppu et al., 2017). Lowering salt content in food has been shown to impact the overall palatability of foods by suppressing the perception of unfavorable flavors such as bitterness and metallic flavor, while enhancing the preferred sensory characteristics such as salty and sweet taste, and overall flavor intensity (Liem et al., 2011). Various studies report strategies to enhance salty taste or to compensate the decreased palatability of low-salt foods. For example, organic acids commonly used in foods have been shown to be effective at enhancing the saltiness of sodium as well as at improving the palatability of tomato soup (Little & Brinner, 1982). Odor-induced saltiness enhancement was demonstrated by Nasri et al. (2011), who showed that a sardine aroma commonly associated with salty foods enhanced the perception of saltiness in mineral water. Also, a monosodium glutamate (MSG) and nucleotide-induced umami taste in vegetable soups was shown to increase the pleasantness of soups with a 50% lower salt content (Roininen et al., 1996). The first two mentioned strategies – increasing the sour taste and adding flavors commonly associated with savory foods – are easy to implement in practical cooking, for example in the foodservice industry. However, consumer attitudes toward MSG limit the

use of this strategy in reducing the salt content of foods (Prescott & Young, 2002; Wang & Adhikari, 2018).

## Methodology

In this study, we tested whether two common foodservice products with a nutrient content profile that did not meet the criteria for the Heart Symbol, based on Finnish nutritional recommendations, could be reformulated to meet the criteria without sacrificing consumer acceptance (Finnish Nutritional Recommendations, n.d.; Heart Symbol, n.d.). The nutrient criteria of the Heart Symbol address the main nutritional challenges in Finland, including total fat, saturated and trans fats, salt, sugar and fiber, and the main dietary sources of these nutrients as derived from data on population diets. We wanted to study the effect of flavor modification techniques that are easy to apply in the foodservice industry and easy to accept by most consumers when reducing the salt content of foodservice products. The strategies selected were including organic acids and increasing the flavor intensity in the recipes. For fat reduction, a commonly used strategy in addition to total fat amount reduction is to replace high-fat cream with low-fat cream in a recipe. The

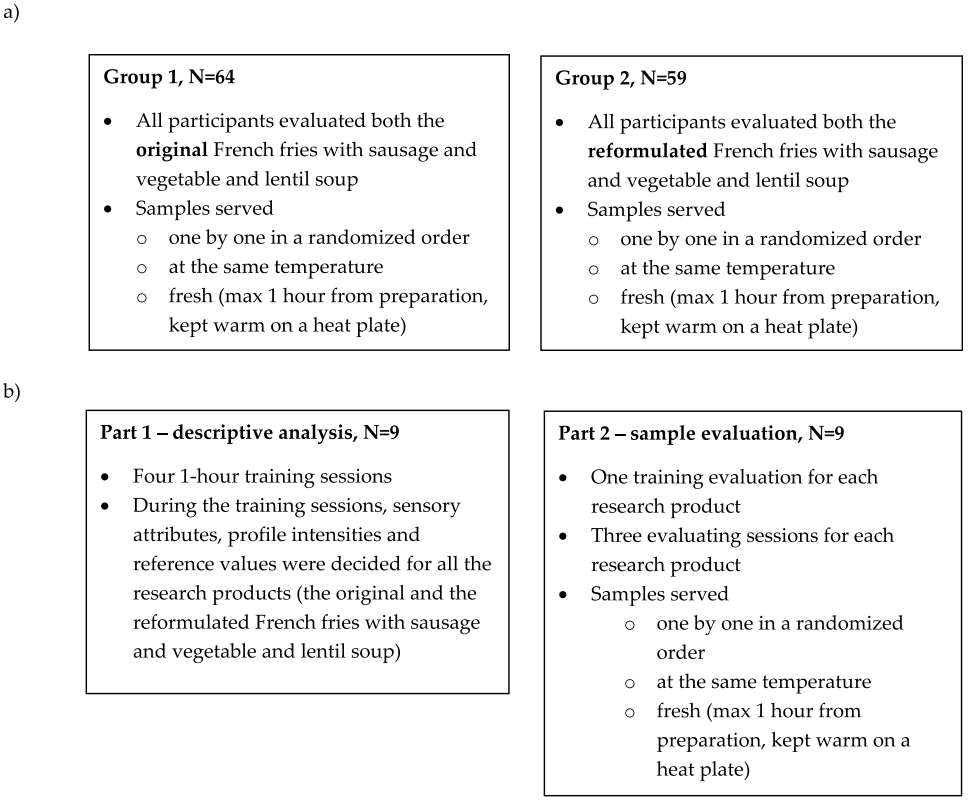


**Figure 2.** Study design for a) the consumer study and b) the sensory profile analysis.

selected research products represented both healthy (vegetable and lentil soup) and unhealthy (French fries with sausage) product images (Photo 1, Paakki et al., 2022). There are several products with similar nutritional compositions on the Finnish market, in both the retail and foodservice sectors. The original and reformulated products were tested by consumers and sensory panel professionals (Figure 2). To our knowledge, no previous scientific study has demonstrated the successful use of salt and fat content reduction compensation techniques in commonly served foodservice products in such a concrete and detailed manner. In this study, we have included recipes and nutrient content calculations as well as a sensory profile analysis of reformulated products in a scientific paper for the first time, which facilitates the implementation of the results in the foodservice industry and the catering field.

a)


b)


**Photo 1.** Photos of the research products, a) the reformulated (on the left) and the original vegetable and lentil soup and b) the reformulated (on the left) and the original French fries with sausage.

### Sample preparation

The reformulated products were developed in fall 2021 for a collaborative consumer study in South Ostrobothnia, Finland. Two foodservice products with different health and nutrition images, vegetable and lentil soup (representing a healthy, less fatty, and salty product) and French fries with sausage (representing an unhealthy, fatty, and salty product), were reformulated to meet the criteria for the Heart Symbol. Despite different health images, neither of the original products met the criteria for the Heart Symbol (Table 1). Compared to the nutritional recommendations and the Heart Symbol criteria, the original vegetable and lentil soup contained too much total and saturated fat as well as salt. In the reformulated product, the amount and quality of fat was improved by decreasing the total amount of oil and replacing full fat cream (fat 35%) with light cream (fat 15%). The flavor change caused by the salt reduction was compensated by increasing the sour taste with acidic apple and lemon juices. In the original recipe consisting of French fries with sausage, the amount and quality of fat was within the nutritional recommendations, but the salt content was well above the recommended level. In the reformulated recipe, the salt reduction was compensated by increasing the flavor intensity with chili powder and onion. During cooking, the onion was roasted, which also emphasized the umami and sweet tastes in the reformulated product. The recipes were developed, and the final products were tested in the training restaurant of Seinäjoki University of Applied Sciences. The study was carried out in collaboration with the Finnish Heart Association, which is responsible for managing the use of the Heart Symbol criteria (Heart Symbol, n.d..). The experts of the Finnish Heart Association reviewed the nutrient content calculations of the reformulated products and approved the recipes developed for the study.

For the consumer study, the research products, both the original and reformulated versions, were prepared according to the researchers' recipes by trained professional chefs at Sodexo Flavoria® lunch restaurant at the University of Turku. The ingredients of the recipes were generally weighed by the professional chefs but the critical ingredients (salt and spices), were weighed by the researchers to ensure the correct salt content and taste balances of the research products. Also, the product samples for the sensory profile analyses were prepared in an experimental kitchen by trained researchers with the same recipes.

### Consumer study

The consumer study ($N = 123$, aged 19–70 years, mean 38.5 years, females 74.8%) was conducted in a multisensory research laboratory (Aistikattila®,

**Table 1.** Composition and nutrient content of the research products, the vegetable and lentil soup (1a) and the French fries with sausage (1b).

| 1a. Vegetable and lentil soup | | 1b. French fries with sausage | |
|---|---|---|---|
| Ingredients, in a descending order | Change (%) in the reformulated recipe | Ingredients, in a descending order | Change (%) in the reformulated recipe |
| Water | <3 | French fries cubes, fat 4%, salt 0.1% | <2 |
| Sweet potato | <2 | Sausage cubes, fat 12%, salt 1.3% | <2 |
| Cream, fat 35% | **−13**[#] | Onion | **+31** |
| Carrot | <1 | Salt | **−46** |
| Lens, dried | <2 | Chili powder | **+30** |
| Onion | <1 | | |
| Apple juice | **+20** | | |
| Rapeseed oil | **−20** | | |
| Salt | **−17** | | |
| Lemon juice | **+40** | | |
| Garlic | <1 | | |
| Thyme | 0 | | |
| **Nutrient content, reformulated product/100 g[##] (change compared to the original recipe, %)** | | **Nutrient content, reformulated product/100 g[##] (change compared to original recipe, %)** | |
| Energy, kcal | **76 (−25)** | Energy, kcal | 156 (<5) |
| Fat, total | **3.1 (−47)** | Fat, total | 6.5 (<5) |
| Fat, saturated | **1.0 (−62)** | Fat, saturated | 1.25 (<5) |
| Carbohydrate | 8.2 (0) | Carbohydrate | 19 (<5) |
| Fibre | 2.3 (0) | Fibre | 2.1 (<5) |
| Protein | 2.7 (0) | Protein | 5.1 (<5) |
| Salt | **0.69 (−17)** | Salt | **0.71 (−28)** |

[#]In addition to the decrease in the total amount of cream, full fat cream 35% fat was changed to light cream 15% fat.
[##]Criteria for the Heart Symbol according to the Finnish Heart Association.
Vegetable and lentil soup: Fat content 3.1–6 g/100 g, saturated fat max 1.5 g, salt max 0.70 g/100 g
French fries with sausage: Fat content 2.1–8 g/100 g, saturated fat max 33% of total fat, salt max 0.75 g/100 g

Flavoria research platform, University of Turku). Each participant evaluated both research products (vegetable and lentil soup and French fries with sausage), either the original ($N = 64$, aged 21–70 years, mean 39.6 years, females = 76.6%) or the reformulated ($N = 59$, aged 19–68 years, mean 37.2 years, females = 72.9%) versions, in a randomized order (Figure 2). The research products were prepared before each evaluation session and kept warm on a heating plate (max. 1 hour), and dished out just before the evaluation. Consumer acceptance was evaluated by asking about the appearance, smell, taste, texture, and overall pleasantness of the original and the reformulated products. Seven-point Likert-scales from 1 (very unpleasant) to 7 (very pleasant) were used to measure pleasantness. One-way ANOVA was used to detect the effects on the variables between the groups. The data was collected using Compusense Cloud software, version 22.0 (Compusense Inc., Guelph, Ontario, Canada). Statistical analyses were performed using IBM SPSS Statistics, version 28.0. This study was part of a larger study on eating behavior, where the participants ($N = 355$, aged 19—70 years, mean 38.1 years, females 74.1%) were exposed to health labeling and multisensory eating simulation exercise. The results of this paper are based on the control group of this study, with no exposure to health labeling or eating simulation.

### *Sensory profile analysis*

In addition to the consumer study, the descriptive profiling of the research products was done by experienced trained sensory professional panelists ($N = 9$, ISO 8589 sensory evaluation laboratory, Lawless & Heymann, 2010). The descriptive analysis consisted of four one-hour training sessions, one training evaluation, and three evaluation sessions. In the first training session, the samples were presented to the panelists, who were asked to describe their odor, appearance, texture, mouthfeel, taste, and flavor, and this was followed by a group discussion. In the further training sessions, the verbal descriptions of the lexicon were clarified, and the reference values for the sensory profile intensities of the product samples were mutually agreed and decided on (Figure 2). The final sensory profile of the French fries with sausage consists of 13 sensory attributes (four odor, one mouthfeel, two taste, and six flavor properties), and the vegetable and lentil soup had 16 sensory attributes (four odor, one mouthfeel, two taste, and nine flavor properties).

All the samples were evaluated in triplicate during the three different sessions on a scale of 0 (min) to 10 (max). The samples were served one by one from the heating plate, and the evaluation order was randomized both between the panelists and between the sessions. The data was collected using the Compusense Cloud software, version 22.0 (Compusense Inc., Guelph, Ontario, Canada). The difference between the attributes in the original and

the reformulated samples was tested with Student's t-test (IBM SPSS Statistics for Windows, Version 28.0).

## Results

### *The reformulated recipes*

In the reformulated vegetable and lentil soup, the salt content was decreased by 17%, rapeseed oil content by 20%, and the amount of full cream (35% fat) was replaced by a 13% lower amount of light cream (15% fat). Following these recipe modifications, the reformulated vegetable and lentil soup met the Heart Symbol criteria of the Finnish Heart Association. The reduced salt content was compensated by increasing the amount of apple juice (+40%) and lemon juice (+20%) in the recipe. During the product development process, the increased amount of herb (thyme) was also tested, but based on a pretest consumer evaluation, the amount of herb was not changed in the reformulated vegetable and lentil soup. In the reformulated French fries with sausage product, the reduced salt content (−46%) was compensated by increasing the amount of onion (+30%) and chili powder (+31%) in the recipe (Table 1).

As a result of the recipe reformulation, the nutrient profile of the vegetable and lentil soup improved remarkably, with reductions of 25% in energy, 47% in total fat, 62% in saturated fat, and 17% in salt content. The improvement in the nutritional profile of the French fries with sausage product was the markedly (−28%) decreased salt content (Table 1).

### *Consumer evaluation*

Consumer acceptance was evaluated by asking the participants to evaluate the pleasantness of the appearance, smell, taste, texture, and the overall pleasantness of the original and the reformulated products. Compared to the original, the reformulated French fries with sausage achieved higher ratings in pleasantness of appearance (Mean±SD: 4.85 ± 1.38 vs 4.03 ± 1.37, $p < 0.001$) and smell (5.68 ± 1.36 vs 5.08 ± 1.37, $p = 0.016$), but there was no difference in overall pleasantness (4.93 ± 1.22 vs 4.80 ± 1.28, $p = 0.549$) between the products. The vegetable and lentil soup had similar results; no difference in overall pleasantness (5.86 ± 0.99 vs 5.77 ± 1.22, $p = 0.624$) between products, but the smell of reformulated product received a higher rating (5.53 ± 1.39 vs 4.95 ± 1.28, $p = 0.019$), and had a conditional positive effect on appearance (6.15 ± 0.78 vs 5.80 ± 1.30, $p = 0.071$) compared to the original product.

### *Sensory profiles*

The trained sensory panel evaluated the sensory profile of the products using 16 sensory attributes for the vegetable and lentil soup and 13 sensory attributes

for the French fries with sausage. Among the trained panelists, the original vegetable and lentil soup was evaluated as significantly richer in texture-mouthfeel ($p = 0.039$) than the reformulated version. Also, the creaminess of

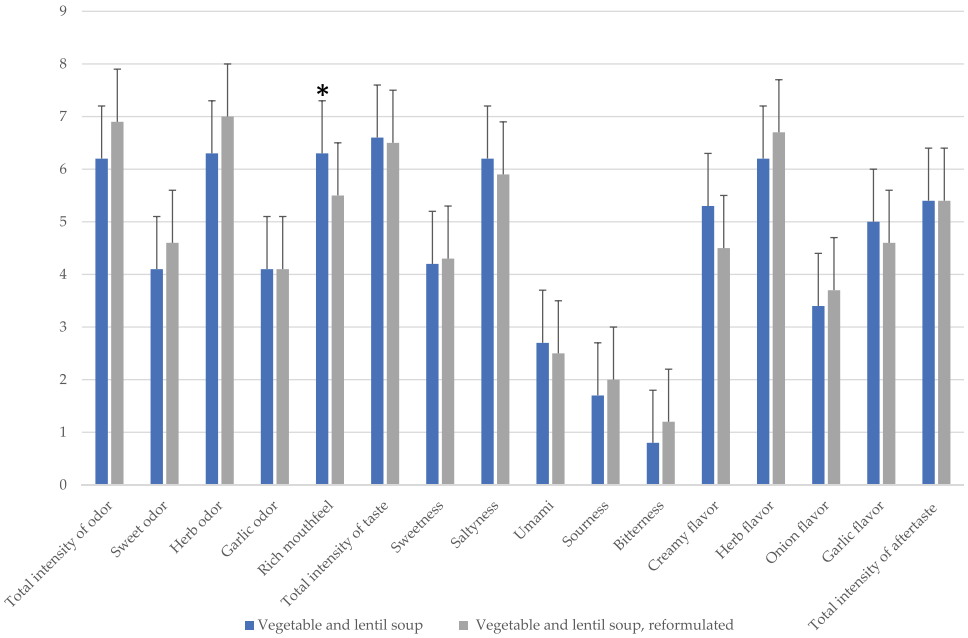


**Figure 3.** Mean intensities ($n = 27$) with the standard deviations of the sensory attributes in the sensory profile of the original and the reformulated vegetable and lentil soup.

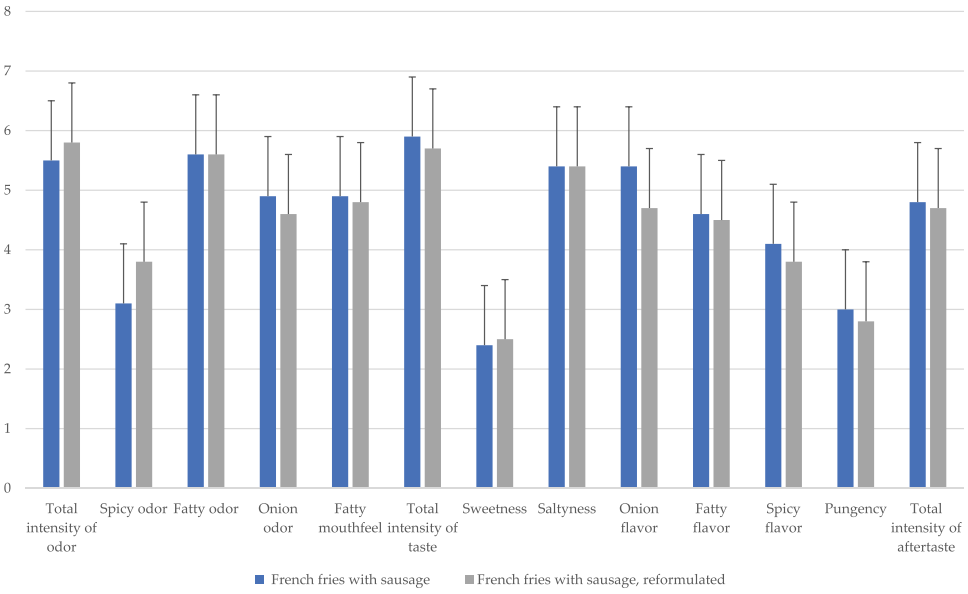


**Figure 4.** Mean intensities ($n = 27$) with the standard deviations of the sensory attributes in the sensory profile of the original and the reformulated French fries with sausage.

the original vegetable and lentil soup tended to differ significantly from the reformulated soup ($p = 0.058$). However, no differences in sensory attributes between the original and the reformulated French fries with sausage products were observed (Student's t-test, Figures 3, and 4).

## Discussion

Reformulation has so far mainly been performed to improve the nutritional quality of processed products, for food industry purposes. For example, in the food industry, significant reductions in salt and fat content as well as in overall fatty acid profiles have been achieved in many product categories without affecting consumer product acceptance (Bruce, 2020; Buttriss, 2013; Fouladkhah et al., 2015; Hoppu et al., 2017; van Raaij et al., 2009). As most current technological solutions focus on the development of industrial processes, there has been little research on basic recipe modification techniques and compensating methods for unhealthy ingredients in the foodservice field. However, as OOH eating is increasing, the foodservice industry also needs new ways to improve the nutritional quality of served foods.

This study showed that the nutritional profile of different foodservice products can be significantly improved by simple recipe modification techniques, without adverse effects on consumer acceptance. The salt and fat content in the reformulated products was decreased to a maximum of 27% and 62%, respectively, using basic recipe compensation techniques, simply by balancing taste, appearance and smell through the spiciness, sweetness, and sourness of the products. The results suggest that consumers may even prefer reformulated products if the recipe is carefully designed to compensate for the altered sensory profile of the reformulated product. It seems that with the right kind of compensation techniques, it is possible to produce not only healthier but even more tasty products. Furthermore, the sensory professionals found differences only in a few sensory attributes, similarly indicating the power of research-based strategies to modify the sensory profile of low-salt and low-fat food products. Recommended compensation techniques for salt reduction in soups and ready meals not only include a total and gradual reduction in the use of NaCl, but also an increased use of herbs, spices, acidic ingredients, and sweet tastes (Buttriss, 2013; Hoppu et al., 2017; Liem et al., 2011). In the reformulated French fries with sausage, the salt reduction was compensated with an increased amount of onion (31%) and chili powder (30%). As a result, the spicy flavor effect of chili powder was balanced and enhanced by sweet and umami tastes created with roasted onion in the reformulated French fries with sausage. This was confirmed by the consumer evaluation, as despite the increased amount of chili and onion in the recipe, the consumers did not find the reformulated French fries with sausage spicier or

more onionous than the original product. In addition, compared to the original the consumers did not find the reformulated product less salty, even though the amount of salt was significantly reduced in the reformulated product. As a matter of fact, past studies have demonstrated that consumers' ability to discriminate between different tastes is relatively low – and can be influenced by subtle non-evaluative cues such as the hue of orange juice (Hoegg & Alba, 2007). Thus, consumers' taste perception is a highly malleable and subjective experience, shaped by many marketing cues (e.g., brand, price, package claims) and consumer characteristics, e.g., values, food neophobia, demographics, and their interactions (Allen et al., 2008; Paasovaara et al., 2012).

Furthermore, the sensory professionals found a sweet taste in the sensory profile of the reformulated French fries with sausage, even though the difference in sweetness between the original and the reformulated products was not significant. It seems that the increased amount of chili powder and roasted onion also made the appearance of the reformulated product more pleasant. In the reformulated vegetable and lentil soup, the salt reduction was compensated with an increase of acidic apple (+20%) and lemon (+40%) juices. The increased quantity of herbs is one of the recommended salt reduction compensation techniques in ready meals (Fouladkhah et al., 2015; Hoppu et al., 2017). Interestingly, we found during the product development process that, to gain consumer acceptance, the amount of thyme had to be kept at the original level in the reformulated vegetable and lentil soup. In an earlier study, Wang et al. (2014) also found that herbs must be used with caution, as excessive amounts of herbs reduce the overall acceptance of soups. The panel of trained sensory professionals clearly distinguished the flavor and odor of the herb both in the original and in the reformulated soups. Compared to the reformulated vegetable and lentil soup, the original soup contained more fat and full fat cream, and, consequently, the original soup was evaluated to have more fullness in its texture and creaminess in its flavor. However, the consumers did not notice any difference in overall pleasantness between the original and the reformulated soup.

### *Theoretical implications*

The results from our study confirm the findings of earlier studies on the use of common salt and fat reduction compensation techniques in ready-to-eat foods, and these recipe compensation techniques can be recommended to be more widely used in the foodservice and catering sectors. Since OOH has increased significantly in recent years, the societal and managerial implications of these actions would be extensive.

More attention and resources should be allocated to the testing and implementation of compensation techniques in the foodservice industry.

A food supply approach is central to achieving significant improvements in diet. Recently, White et al. (2020) argued that the commercial food system in particular has a significant role in taking leadership to support dietary public health, although systemic-level governmental changes are needed. The authorities are making progress on the matter, as, for example, the European health authorities are developing guidelines and operating models for the reformulation of processed foods, not only for large manufacturers but also for small and medium-sized enterprises (WHO European Region, 2021a).

To reach health improvement goals, further actions are needed. Based on our studies, these actions should include more innovative approaches and extensive piloting. Reformulated menu planning should be done gradually, carefully testing the customer acceptance of each recipe change. In addition, more consumer acceptance research is needed to understand customers' reactions to reformulated products in the foodservice sector. Communication about healthy food choices should also be carefully considered and tested. It is still unclear whether reformulation should be done "silently," or whether the customer should be informed of healthier options. Several earlier studies have shown that lay beliefs prevent rather than facilitate healthy eating habits (Chandon & Wansink, 2007; Paakki et al., 2022; Stastny et al., 2011; Suher et al., 2016). According to a study conducted by Giazitzi and Boskou (2021) most foodservice outlets customers welcome nutritional information on their menu cards. However, a recent study by Byrd and Almanza (2021) found that menu labeling with a sodium warning symbol even might have harmful consequences in the foodservice sector. Earlier, Turnwald and Crum (2019) showed that healthy foods should be promoted with taste-related arguments rather than healthiness-related ones.

### *Practical implications*

Successful reformulation requires product development resources, which are not available in all professional kitchens. Therefore, efforts should be made to effectively share knowledge and know-how. Thus, the importance of chef training plays a crucial role in the development of healthier foods (Bertoldo et al., 2022; Tsui & Morillo, 2016). For example, the training of chefs could include "healthier menu developer certificates" (cf., e.g., hygiene certificates) and governments should subsidize healthier menus. Utilizing modern technologies such as digital recipe banks and recipe editing tools in the training of chefs would be cost-effective and have a widespread impact on the foodservice industry and on OOH eating. Also, food industry and large foodservice companies with better resources and wider knowledge could help smaller companies with planning, testing, and implementing reformulation techniques. Such co-operation would be beneficial and valuable to society as a whole. Standardized

regulations and maximum content limits should be defined for the most critical nutrients, especially for salt and fat. A study conducted among Dutch industrial representatives showed that the food industry welcomes reformulation, but at the same time it wishes to have greater government support and similar regulation for all companies (van Gunst et al., 2018). Knowledge sharing among food supply actors could be done through conferences, websites, and newsletters dedicated to reformulation. Open collaboration that encourages everyone to openly share their ideas, as we did in our research by sharing a detailed recipe, is critical to success and achieving a common goal. Similar recommendations were presented as early as in 2010 by the U.S. Institute of Medicine, for example, but no significant implementation has taken place so far in the foodservice sector. More recently, the WHO European region (2020) published a list of actions for different supply chain actors to accelerate salt intake reduction.

## Study limitations and future prospects

The study was conducted with only two products. Future actions should include testing the salt and fat reduction techniques in various types of ready meals, and among larger study groups, as well as among different age groups and in different foodservice environments.

Recipe development was performed by researchers with a hospitality management background, and the products were tested in research environments. A real-life environment study with chefs would have given additional insight to the study, which must be taken into account in future studies. Several earlier studies have shown that the development of healthier products and menus motivates many chefs (Bertoldo et al., 2022; Gillis et al., 2020).

Moreover, future research needs to address the effects of longer storage and shelf-life on the sensory quality of reformulated products. In reformulation techniques, the implementation of closer co-operation among food supply actors is recommended. Previous examples of successful cooperation among actors in the food supply chain have been presented, e.g., in preventing food waste, promoting sustainable business through information technology, knowledge sharing, and product development (Ersoy et al., 2022; Göbel et al., 2015; Krogager et al., 2016). More generally, the importance of co-innovation practices and management within food supply chains is becoming more and more recognized (Misra & Mention, 2022).

Consumers' perceptions of healthy food are variable, and there is clearly not enough information about consumers' motivations to choose a healthy product. Further research is needed on the factors that most influence healthy food choices, and how to influence customers' choices of healthier alternatives.

## Conclusion

In this study, we successfully tested simple ways to reformulate common foodservice products through basic recipe compensation techniques for salt and fat content reductions. Compared to the original products, only minimal differences were observed in the reformulated ones, and the overall pleasantness of the reformulated products was actually perceived to be higher. In conclusion, these techniques should be widely implemented by the foodservice industry, and authorities should encourage foodservice industry experts to adopt reformulation and provide funding for training in reformulation and recipe modification techniques in the foodservice sector. Closer cooperation and knowledge sharing between actors in the food supply chain is recommended.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Funding

This research was funded by Business Finland (1194/31/2020, University of Turku; 1197/31/2020, Seinäjoki University of Applied Sciences; 1199/31/2020, University of Vaasa).

## ORCID

Terhi Junkkari http://orcid.org/0000-0001-8816-7312
Anu Hopia http://orcid.org/0000-0002-1280-5637
Maija Kantola http://orcid.org/0000-0002-9522-9822
Harri Luomala http://orcid.org/0000-0002-9708-994X

## Data availability statement

Data is available from the corresponding author upon request.

## References

Allen, M. W., Gupta, R., & Monnier, A. (2008). The interactive effect of cultural symbols and human values on taste evaluation. *Journal of Consumer Research*, *35*(2), 294–308. https://doi.org/10.1086/590319

Bédard, A., Lamarche, P. O., Grégoire, L. M., Trudel-Guy, C., Provencher, V., Desroches, S., Lemieux, S., & De Steur, H. (2020). Can eating pleasure be a lever for healthy eating? A systematic scoping review of eating pleasure and its links with dietary behaviors and health. *PLoS One*, *15*(12), e0244292. https://doi.org/10.1371/journal.pone.0244292

Bertoldo, J., Hsu, R., Reid, T., Righter, A., & Wolfson, J. A. (2022). Attitudes and beliefs about how chefs can promote nutrition and sustainable food systems among students at

a U.S. culinary school. *Public Health Nutrition*, *25*(2), 498–510. https://doi.org/10.1017/S1368980021003578

Briers, B., Huh, Y. E., Chan, E., & Mukhopadhyay, A. (2020). The unhealthy = tasty belief is associated with BMI through reduced consumption of vegetables: A cross-national and mediational analysis. *Appetite*, *150*, 104639. https://doi.org/10.1016/j.appet.2020.104639

Bruce, J. H. (2020). The technological challenges of reducing the saturated fat content of foods. *Nutrition Bulletin*, *54*(3), 351–320. https://doi.org/10.1111/nbu.12452

Buttriss, J. (2013). Food reformulation: The challenges to the food industry. *Proceedings of the Nutrition Society*, *72*(1), 61–69. https://doi.org/10.1017/S0029665112002868

Byrd, K., & Almanza, B. (2021). Restaurant menu labeling for calories and sodium: Effect of consumer mindset of immediate versus future consequences. *Journal of Foodservice Business Research*, *24*(3), 310–347. https://doi.org/10.1080/15378020.2020.1849765

Chandon, P., & Wansink, B. (2007). The biasing health halos of fast-food restaurant health claims: Lower calorie estimates and higher side-dish consumption intentions. *Journal of Consumer Research*, *34*(3), 301–314. https://doi.org/10.1086/519499

Council of the European Union. (2016). Council conclusions on food product improvement (2016/C269/04). *Official Journal of the European Union*, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016XG0723(01)&from=EN

Earle, M., Earle, R., & Anderson, A. (2017). *Food product development: Consumers' avoidance and acceptance of new products*. Woodhead Publishing Limited. Web Edition published by NZIFST (Inc.). https://nzifst.org.nz/resources/foodproductdevelopment/Chapter-5-3.htm

Eilander, A., Harika, R. K., & Zock, P. L. (2015). Intake and sources of dietary fatty acids in Europe: Are current population intakes of fats aligned with dietary recommendations? *European Journal of Lipid Science and Technology*, *117*(9), 1370–1377. https://doi.org/10.1002/ejlt.201400513

Elitzak, H., & Okrent, A. M. (2018). A retrospective of food-away-from-home expenditures from 1987 to 2017. In M. J. Saksena, A. M. Okrent, & K. S. Hamrick (Eds.), *America's eating habits: Food away from home* (pp. 23–34). U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/webdocs/publications/90228/eib-196.pdf?v=7451.7

Ersoy, P., Börühan, G., Kumar Mangla, S., Hormazabal, J. H., Kazancoglu, Y., & Lafcı, Ç. (2022). Impact of information technology and knowledge sharing on circular food supply chains for green business growth. *Business Strategy and the Environment*, *31*(5), 1875–1904. https://doi.org/10.1002/bse.2988

EU. (2016). *Roadmap for Action on Food Product Improvement*. https://www.ruokavirasto.fi/globalassets/teemat/terveytta-edistava-ruokavalio/ravitsemussitoumus/eu_roadmap-for-action-on-food-product-impvovement_2016.pdf

Finnish nutritional recommendations 2014. (n.d.). *Food-Based Dietary Guidelines – Finland*. (in Finnish: Terveyttä ruoasta. Suomalaiset ravitsemussuositukset 2014). https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/finland/en/

Fouladkhah, A., Berlin, D., & Bruntz, D. (2015). High-sodium processed foods: Public health burden and sodium reduction strategies for industry practitioners. *Food Review International*, *31*(4), 341–354. https://doi.org/10.1080/87559129.2015.1022829

Freedman, M. R., & Larner, J. M. (2011). Point-of-selection nutrition information influences choice of portion size in an all-you-can-eat university dining hall. *Journal of Foodservice Business Research*, *14*(1), 86–98. https://doi.org/10.1080/15378020.2011.548228

Giazitzi, K., & Boskou, G. (2021). Preferences for nutrition information in foodservice outlets among Greek consumers. *Journal of Foodservice Business Research*, *24*(5), 612–627. https://doi.org/10.1080/15378020.2021.1924535

Gillis, L., Whibbs, R., & Li, A. (2020). Future chefs' beliefs on the role of nutrition, diet, and healthy cooking techniques in culinary arts training for foodservice: A cross-cultural and gender perspective. *Journal of Culinary Science & Technology*, *18*(4), 348–365. https://doi.org/10.1080/15428052.2020.1808138

Göbel, C., Langen, N., Blumenthal, A., Teitscheid, P., & Ritter, G. (2015). Cutting food waste through cooperation along the food supply chain. *Sustainability*, *7*(2), 1429–1445. https://doi.org/10.3390/su7021429

Guthrie, J., Lin, B. H., & Smith, T. A. (2018). Impacts on nutrient intakes from increased food-away-from-home consumption. In M. J. Saksena, A. M. Okrent, & K. S. Hamrick (Eds.), *America's eating habits: Food away from home* (pp. 96–106). U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/webdocs/publications/90228/eib-196.pdf?v=7451.7

Harastani, R., James, L. J., Walton, J., & Woolley, E. (2020). Tackling obesity: A knowledgebase to enable industrial food reformulation. *Innovative Food Science and Emerging Technologies*, *64*, 102433. https://doi.org/10.1016/j.ifset.2020.102433

Heart Symbol. (n.d.). Criteria. Available at: https://www.sydanmerkki.fi/en/criteria/

Hoegg, J., & Alba, J. W. (2007). Taste perception: More than meets the tongue. *Journal of Consumer Research*, *33*(4), 490–498. https://doi.org/10.1086/510222

Hoppu, U., Hopia, A., Pohjanheimo, T., Rotola-Pukkila, M., Mäkinen, S., Pihlanto, A., & Sandell, M. (2017). Effect of salt reduction on consumer acceptance and sensory quality of food. *Foods*, *6*(12), 103. https://doi.org/10.3390/foods6120103

Institute of Medicine (U.S.). (2010). Committee on strategies to reduce sodium intake. In J. E. Henney, C. L. Taylor, & C. S. BoonEds., *Strategies to reduce sodium intake in the United States* National Academies Press (U.S.). https://pubmed.ncbi.nlm.nih.gov/21210559/

Janssen, A. M., Kremer, S., van Stipriaan, W. L., Noort, M. W., de Vries, J. H., & Temme, E. H. (2015). Reduced-sodium lunches are well-accepted by uninformed consumers over a 3-week period and result in decreased daily dietary sodium intakes: A randomized controlled trial. *Journal of the Academy of Nutrition and Dietetics*, *115*(10), 1614–1625. https://doi.org/10.1016/j.jand.2015.01.008

Krogager, S. G. S., Grunert, K. G., Brunsø, K., Povlsen, K. K., Brock, S., Christensen, T., Edelenbos, M., Kastberg, H., & Mielby, L. H. (2016). Cool snacks: A cross-disciplinary approach to healthier snacks for adolescents. *Trends in Food Science & Technology*, *47*, 82–92. https://doi.org/10.1016/j.tifs.2015.10.009

Lachat, C., Nago, E., Verstraeten, R., Roberfroid, D., Van Camp, J., & Kolsteren, P. (2012). Eating out of home: Influence on nutrition, health, and policies: A scoping review. *Obesity Reviews*, *13*(4), 329–346. https://doi.org/10.1111/j.1467-789X.2011.00953.x

Lawless, H. T., & Heymann, H. (2010). Descriptive analysis. In *Sensory evaluation of food* Food Science Text Series, (pp. 240–245). Springer. https://doi.org/10.1007/978-1-4419-6488-5_10.

Liem, D. G., Miremadi, F., & Keast, R. S. J. (2011). Reducing sodium in foods: The effect on flavor. *Nutrients*, *3*(6), 694–711. https://doi.org/10.3390/nu3060694

Lin, B. H., & Guthrie, J. (2012). Nutritional quality of food prepared at home and away from home, 1977-2008. In *Economic information bulletin number* (Vol. 105). U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/webdocs/publications/43698/34513_eib-105.pdf?v=0

Little, A. C., & Brinner, L. (1982). Taste responses to saltiness of experimentally prepared tomato juice samples. *Journal of the American Dietetic Association*, *84*(9), 1022–1027. https://doi.org/10.1016/S0002-8223(21)08299-7

Ma, G. X., Shive, S., Zhang, Y., Aquilante, J., Tan, Y., Zhao, M., Solomon, S., Zhu, S., Toubbeh, J., Colby, L., Mallya, G., & Zeng, Q. (2014). Knowledge, perceptions, and behaviors

related to salt use among Philadelphia Chinese take-out restaurant owners and chefs. *Health Promotion and Practice*, *15*(5), 638–645. https://doi.org/10.1177/1524839914538816

MacCon Iomaire, M., Afifi, A. F., & Healy, J. J. (2021). Chefs' perspectives of failures in foodservice kitchens, part 1: A phenomenological exploration of the concepts, types, and causes of food production failure. *Journal of Foodservice Business Research*, *24*(2), 177–214. https://doi.org/10.1080/15378020.2020.1842955

Misra, A., & Mention, A.-L. (2022). Exploring the food value chain using open innovation: A bibliometric review of the literature. *British Food Journal*, *124*(6), 1810–1837. https://doi.org/10.1108/BFJ-04-2021-0353

Moran, A. J., Ramirez, M., & Block, J. P. (2017). Consumer underestimation of sodium in fast food restaurant meals: Results from a cross-sectional observational study. *Appetite*, *113*, 155–161. https://doi.org/10.1016/j.appet.2017.02.028

Murray, D. W., Hartwell, H., Feldman, C. H., & Mahadevan, M. (2015). Salt, chefs, and public health: An exploratory investigation of hospitality professionals. *British Food Journal*, *117* (5), 1610–1618. https://doi.org/10.1108/BFJ-07-2014-0237

Nasri, N., Beno, N., Septier, C., Salles, C., & Thomas-Danguin, T. (2011). Cross-modal interactions between taste and smell: Odour-induced saltiness enhancement depends on salt level. *Food Quality and Preference*, *22*(7), 678–682. https://doi.org/10.1016/j.foodqual.2011.05.001

Outila, T., Simulainen, H., Laukkanen, T., & Kyyrö, M. (2006). A simple way of evaluating the healthiness of ready-to-eat foods and developing healthy foods in the food industry. *International Journal of Food Science and Nutrition*, *57*(1–2), 137–142. https://doi.org/10.1080/09637480600658427

Paakki, M., Kantola, M., Junkkari, T., Arjanne, L., Luomala, H., & Hopia, A. (2022). "Unhealthy = tasty": How does it affect consumers' (un)healthy food expectations? *Foods*, *11*(19), 3139. https://doi.org/10.3390/foods11193139

Paasovaara, R., Luomala, H. T., Pohjanheimo, T., & Sandell, M. (2012). Understanding consumers' brand-induced food taste perception: A comparison of 'brand familiarity' and 'consumer value-brand symbolism (in)congruity' accounts. *Journal of Consumer Behaviour*, *11*(1), 11–20. https://doi.org/10.1002/cb.356

Parikh, A. A., & Behnke, C. (2015). Nutrition label formatting: Customer perceptions and behaviors. *Journal of Foodservice Business Research*, *18*(1), 48–57. https://doi.org/10.1080/15378020.2015.995751

Patel, A. A., Lopez, N. V., Lawless, H. T., Njike, V., Beleche, M., & Katz, D. L. (2016). Reducing calories, fat, saturated fat, and sodium in restaurant menu items: Effects on consumer acceptance. *Obesity*, *24*(25), 2497–2508. https://doi.org/10.1002/oby.21684

Pettigrew, S., Rosenberg, M., & Ferguson, R. (2013). Consumers' (in)ability to estimate the energy content of unhealthy foods. *Nutrition and Dietetics*, *70*(4), 307–311. https://doi.org/10.1111/1747-0080.12011

Prescott, J., & Young, A. (2002). Does information about MSG (monosodium glutamate) content influence consumer ratings of soups with and without added MSG? *Appetite*, *39* (1), 25–33. https://doi.org/10.1006/appe.2002.0492

Raghunathan, R., Naylor, R. W., & Hoyer, W. D. (2006). The unhealthy = tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. *Journal of Marketing*, *70* (4), 170–184. https://doi.org/10.1509/jmkg.70.4.170

Reichler, G., & Dalton, S. (1998). Chefs' attitudes toward healthful food preparation are more positive than their food science knowledge and practices. *Journal of the American Dietetic Association*, *98*(2), 165–169. https://doi.org/10.1016/S0002-8223(98)00041-8

Roininen, K., Lähteenmäki, L., & Tuorila, H. (1996). Effect of umami taste on pleasantness of low-salt soups during repeated testing. *Physiology and Behavior*, *60*(3), 953–958. https://doi.org/10.1016/0031-9384(96)00098-4

Rudelt, A., French, S., & Harnack, L. (2014). Fourteen-year trends in sodium content of menu offerings at eight leading fast-food restaurants in the USA. *Public Health Nutrition*, *17*(8), 1682–1688. https://doi.org/10.1017/S136898001300236X

Shan, Z. L., Rehm, C. D., Rogers, G., Ruan, M. Y., Wang, D. D., Hu, F. B., Mozaffarian, D., Zhang, F. F., & Bhupathiraju, S. N. (2019). Trends in Dietary Carbohydrate, Protein, and Fat Intake and Diet Quality Among U.S. Adults, 1999-2016. *JAMA*, *322*(12), 1178–1187. https://doi.org/10.1001/jama.2019.13771

Sharma, S., Wagle, A., Sucher, K., & Bugwadia, N. (2011). Impact of Point of Selection Nutrition Information on meal choices at a table-service restaurant. *Journal of Foodservice Business Research*, *14*(2), 146–161. https://doi.org/10.1080/15378020.2011.574540

Stastny, S. N., Evenson, A., & Mozumdar, A. (2011). Effect of nutrition facts panel and ingredient declaration on customer satisfaction and nutrition perceptions in a table-service restaurant at midday meal. *Journal of Foodservice Business Research*, *14*(4), 310–333. https://doi.org/10.1080/15378020.2011.624051

Stewart, H., Anekwe, T. D., & Hyman, J. (2018). Menu labelling. In M. J. Saksena, A. M. Okrent, & K. S. Hamrick (Eds.), *America's eating habits: Food away from home* (pp. 142–160). U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/webdocs/publications/90228/eib-196.pdf?v=7451.7

Suher, J., Raghunathan, R., & Hoyer, W. D. (2016). Eating healthy or feeling empty? How the "healthy = less filling" intuition influences satiety. *Journal of the Association for Consumer Research*, *1*(1), 26–40. https://doi.org/10.1086/684393

Tsui, E., & Morillo, A. (2016). How cooks navigate nutrition, hunger and care in public-sector foodservice settings. *Public Health Nutrition*, *19*(5), 946–954. https://doi.org/10.1017/S1368980015002086

Turnwald, B. P., & Crum, A. J. (2019). Smart food policy for healthy food labeling: Leading with taste, not healthiness, to shift consumption and enjoyment of healthy foods. *Preventive Medicine*, *119*, 7–13. https://doi.org/10.1016/j.ypmed.2018.11.021

U.S. Department of Agriculture. (2023, July 17). *Market Segments*. https://www.ers.usda.gov/topics/food-markets-prices/food-service-industry/market-segments/

U.S. Government Accountability Office. (2022). *Healthy Eating: Government-Wide Solutions for Promoting Healthy Diets, Food Safety, and Food Security (GAO-22-106078 Healthy Eating)*. https://www.gao.gov/assets/730/721772.pdf

van Gunst, A., Roodenburg, A., & Steenhuis, I. (2018). Reformulation as an integrated approach of four disciplines: A qualitative study with food companies. *Foods*, *7*(4), 64. https://doi.org/10.3390/foods7040064

van Raaij, J., Hendriksen, M., & Verhagen, H. (2009). Potential for improvement of population diet through reformulation of commonly eaten foods. *Public Health Nutrition*, *12*(3), 325–330. https://doi.org/10.1017/S1368980008003376

Vandevijvere, S., Monteiro, C., Krebs-Smith, S. M., Lee, A., Swinburn, B., Kelly, B., Neal, B., Snowdon, W., & Sacks, G. (2013). Monitoring and benchmarking population diet quality globally: A stepwise approach. *Obesity Reviews*, *14*(1), 135S–149S. https://doi.org/10.1111/obr.12082

Wang, C., Lee, Y., & Lee, S. Y. (2014). Consumer acceptance of model soup system with varying levels of herbs and salt. *Journal of Food Science*, *79*(10), 2098S–2106S. https://doi.org/10.1111/1750-3841.12637

Wang, S., & Adhikari, K. (2018). Consumer perceptions and other influencing factors about monosodium glutamate in the United States. *Journal of Sensory Studies*, *33*(4), e12437. https://doi.org/10.1111/joss.12437

White, M., Aguirre, E., Finegood, D. T., Holmes, C., Sacks, G., & Smith, R. (2020). What role should the commercial food system play in promoting health through better diet? *BMJ*, *368*, m545. https://doi.org/10.1136/bmj.m545

WHO. (2018). *Better food and nutrition in Europe: A progress report monitoring policy implementation in the WHO European Region*. https://apps.who.int/iris/handle/10665/345370

WHO European Region. (2020). *Accelerating Salt Reduction in Europe: A Country Support Package to Reduce Population Salt Intake in the WHO European Region*. https://apps.who.int/iris/bitstream/handle/10665/340028/WHO-EURO-2020-1989-41744-57142-eng.pdf

WHO European Region. (2021a). *Healthy and Sustainable Diets – Key Workstreams in the WHO European Region. Factsheet 2021*. https://www.who.int/europe/publications/i/item/WHO-EURO-2021-2192-41947-57624

WHO European Region. (2021b, September 20). *The Out-Of-Home Food Sector – Exponential Growth in an Unregulated Market*. https://www.who.int/europe/news/item/20-09-2021-the-out-of-home-food-sector-exponential-growth-in-an-unregulated-market