

AMERICAN UNIVERSITY OF BEIRUT

KNOWLEDGE, ATTITUDES AND PRACTICES TOWARDS  
FOOD ADDITIVES AMONG LEBANESE STUDENTS

by  
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A thesis  
submitted in partial fulfillment of the requirements  
for the degree of Master of Science  
to the Department of Nutrition and Food Sciences  
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# ABSTRACT OF THE THESIS OF

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Title: Knowledge, Attitudes and Practices towards Food Additives among Lebanese students

Food additives are substances, natural or synthetic, added to foods to increase their shelf life, improve their appearance or maintain their freshness. Intensive research was performed on food additives to ensure their safe consumption. The objective of this study is to 1) assess the knowledge, attitudes, and practices towards food additives among AUB students, 2) identify the association between socio-demographic factors and food additives, (3) and identify the association between the knowledge, attitudes, and practices. A descriptive, cross-sectional study was conducted among Lebanese AUB students that are at least 18 years of age. The online survey was divided into six different sections and included 30 questions, and was sent via social media, mainly WhatsApp and Instagram. Among 191 participants, 52.8% had a low knowledge score and 47.1% had a high knowledge score. There were no significant differences between the participants' socio-demographic backgrounds and their total knowledge score. There was a weak positive correlation between attitudes and practices, which implied that good attitudes result in better practices. Food additives have existed for decades and are crucial in food technology. Participants showed low levels of knowledge towards food additives which is why more awareness and educational workshops must be provided in Lebanon. Future research must be conducted to learn more about the association between food additives and food safety in Lebanon.

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# CHAPTER I

## INTRODUCTION AND LITERATURE REVIEW

### **A. Introduction**

Additives play an essential role in our food supply and are mostly necessary to ensure a decent quality of food. Strict controls and scientific studies are being made to identify their safe consumption [Kayışoğlu & Coşkun, 2016]. Although their use is associated with greater safety and freshness of the food product, they might also present side effects such as food allergies, a decrease in the absorption of vitamins and minerals, and more [Kayışoğlu & Coşkun, 2016]. The Food and Drug Administration (FDA) has a list of more than 3000 ingredients "Everything Added to Food in the United States", many of which we use in our daily lives (e.g., sugar, baking soda, salt, vanilla, yeast, spices, and colors) [FDA, 2018]. A lot of studies were conducted on the consumers' perception of food additives and many of them are unfamiliar with the advantages of food additives and labeled them as unhealthy. Even though food additives are extensively used during food processing globally, people's concerns about their risks have not subsided. In the past few years, consumers have become more involved in their quality of life which increased their demand for natural food that is free from additives [Zhong, et al., 2018].

### **B. Food Additives: Definition, Usage and Types**

Food additives are substances added to food to enhance their safety, maintain their freshness, and texture, or improve their appearance. There are some food additives that have been used for years for preservation purposes such as salt, sugar, and other

spices. Salt has been used to preserve meat and fish whereas sugar has been useful for fruit preservation. Over the years, food additives have been serving food production where they were able to ensure the safety of processed food as well as keep them in decent condition throughout their transportation stages. All food additives must be authorized before being used in food. Thus, for simplification purposes, an “E-number” is given to each additive (I.e., 1169/2011/EU; European Parliament, Council of the European Union 2011) [Szucs, et al., 2019]. Sources of food additives vary as they can be obtained from animals, plants, minerals, or synthetic. The use of food additives is related to technological purposes and each food additive is designed to perform a specific job to promote the safety and appearance of the food product.

Furthermore, these substances could be added at any stage whether it was in the production, processing, treatment, packaging, or storage of food [FDA, 2018]. There are two types of food additives: direct and indirect. Direct food additives have a specific purpose in the food. Xanthan gum is an example of a direct food additive that is added to salad dressings, bakery fillings, or pudding to provide texture. Usually, direct additives are mentioned in the ingredient label of foods [FDA, 2018]. Indirect food additives are those that become part of the food in trace amounts because of its packaging, storage, or other handling [FDA, 2018]. Little amounts of packaging substances are still found in foods during storage. Manufacturers ensure the safety of all materials that are in contact with food and submit it to the U.S. Food and Drug Administration (FDA). Food additives come in several types that include anti-caking agents, antioxidants, emulsifiers, colors, flavors, mineral salts, foaming agents, thickeners, raising agents ...

### **C. Categories of Food Additives**

WHO and FAO group food additives into three categories: flavoring agents, enzyme preparations, and other additives [WHO, 2018].

Flavoring agents are added to food to enhance taste and aroma. They are the largest of the food additives groups. The natural flavoring agents include nut, spice blends, and fruit. There are also chemical flavorings that are intended to imitate the natural flavor.

Enzyme preparations might take part in the final food product. Enzymes are proteins that have catalytic properties where they break down large molecules into smaller ones. They are used to improve the dough in baking, to increase yields in fruit juices, and to improve curd formation in cheese manufacturing [WHO, 2018].

The final group of food additives includes substances that are used for preservation, sweetening, and coloring. They are used in the preparation, packaging, transportation, or storage phase which makes them a constituent of the food product. For instance, coloring is added to make up for the coloration lost during the preparation process which makes the food look more appealing to the consumer. A color additive is a pigment that could be applied to food, drug, or cosmetics [FDA, 2018]. Color could be lost due to exposure to light or air. It can also be affected by temperature or storage conditions. However, a color additive does not always make up for the color loss; it can also enhance natural coloration in the food. For example, colas gained their brown color due to color additives. FDA listed all the colors that are certified and the ones that are exempted from certification after intensive safety standards. There are nine certified color additives in the United States (FD&C Yellow No.6)[FDA, 2018]. Sweeteners are defined as sugar-alternatives that provide little to no calories in the food. Sweeteners are

usually odorless, colorless, and soluble in water. Sweeteners are divided into high intensity and bulk. While high-intensity sweeteners are considered to have a greater sweetness than sugar and are provided in low quantities, bulk sweeteners provide energy and bulk to the food they are added to.

Furthermore, sweeteners could be either natural or synthetic. The natural ones include dietary sweeteners such as sucrose, fructose, lactose, and maltose with sucrose being the major one among them. The synthetic sweeteners are referred to as high potency sweeteners (HPS) and they include saccharin, cyclamates, aspartame, and acesulfame-K. These are consumed by people who cannot have sugar due to health reasons.

#### **D. Safety of Food Additives**

As a result of people's concerns about the risks of food additives, a list of synthetic food additives was identified as potential food-safety hazards. In China, issues related to misuse and overuse of food additives and the use of "non-edible chemical substances" have increased. It was reported that the highest number of food safety related incidents was due to the illegal use of food additives (34.36%) [Zhong, et al., 2018]. Furthermore, China's state Food and Drug Administration stated lately that 8224 batches of substandard food were found (out of 257,000), out of which 33.6% was caused by the overuse or misuse of food additives by food production organizations [Zhong, et al., 2018]. There are some illegal enterprises that have been using non-edible chemical substances for the purpose of increasing their profit which negatively affected people's health.

Food safety issues have been on the rise in Europe as well. So, the safety of all food additives was assessed by the Scientific Committee on food (SCF) and/or the

European Food Safety Authority (EFSA) [Szucs, et al., 2019]. A recent study in Switzerland showed that consumers were concerned about the presence of chemicals in their diet and would rather go for natural food) [Szucs, et al., 2019]. Another study that was done in Germany showed the concern of consumers about food additives and genetic modification) [Szucs, et al., 2019]. Other surveys from Asian countries also showed that consumers labeled food additives as potential hazards and would rather consume food with no-additive [Varela & Fiszman, 2012].

Titanium dioxide (TiO<sub>2</sub>) is an additive used in foods as a color. Similarly to all food colorants, its main purpose is to make food more appealing or make up for the color loss during food processing. It is usually found in salad dressings, snacks, creamers, spreads, candies and sweets. In recent years, titanium dioxide gained a significant amount of attention among scientists and researchers. One of the studies showed that prolonged intake of TiO<sub>2</sub> nanoparticles (for almost 100 days) developed intestinal low-grade inflammation and was associated with colon carcinogenesis [Laudisi et al., 2019].

Investigations on the safety of food additives included acute toxicity, short-term exposure at different doses, and long-term exposure. It could either be considered safe or allowed to be used within a certain dose in specific foods (Acceptable Daily Intake ADI) [Bearth, et al., 2014].

### **E. Knowledge and perception of consumers about Food Additives**

Consumers' perceptions of any food ingredient shape its commercial future. Several studies have been done to assess people's perception of food additives. Yet not all food additives are perceived in the same way [Bearth, et al., 2014].

Although science claimed that there is no difference between a natural and an artificial additive, consumers tend to differentiate between them. A study was done in Spain where consumers were asked to define the term “food additive.” The results showed confusion especially that some participants mentioned sugar, salt, and spices and others mentioned preservatives, colors, and sweeteners. Among the various categories of food additives, color additives and sweeteners are the most controversial because unlike preservatives, they do not contribute to food safety [Bearth, et al., 2014].

In China, two surveys that were conducted showed that Chinese consumers perceive substantial risk of food additives. This results in failure for consumers to understand the role of food additives as well as affecting the general opinion and leading consumers to lose trust in processed foods and the government [Miao, et al., 2019]. A study done in China reported that higher knowledge levels alleviate negative effects of risk perception of food safety on risk perception of food additives. Also, it showed the importance of knowledge to decrease risk perception of food additives [Miao, et al., 2019].

Another study was done in Bosnia and Herzegovina on the knowledge of young consumers on food quality and food additives. The results showed that students with less knowledge of food quality and food additives had difficulty in understanding the role of additives and their usage in food processing [Slavica & Radoslav, 2013].

A study in Nigeria explored knowledge and perception of food additives by female lecturers and reported that 65.3% of them had good knowledge of food additives. Whereas 46.3% of the lecturers had a good perception of food additives and the majority (97.1%) consumed them regardless. 77.8% reported that risks accompanied

with food additives should be further investigated. However, consumption rates were high for natural and synthetic food additives [Ibrahim, et al., 2021].

### **F. Avoidance and trust of Food Additives**

In food production and preservation, food products must meet people's expectations in terms of quality, appearance, taste, price, and many various factors. The use of food additives is known to be one of the solutions to fulfill these requirements. "E-numbers" have caused concern in a lot of consumers, the thing that drove food producers to mention the name of the additive instead, in order to avoid having too many E-numbers [Szucs et al., 2019].

Previous studies suggested that trust in the government has a direct impact on risk perception and consumption of food products. A study was conducted in three European countries, Hungary, Romania and Spain in 2019. Results showed that in order to modify the avoidance of food additives, decreasing perceived risk is needed. In other words, consumers' perception towards food additives is highly dependent on their overall trust in food safety in their countries [Szucs et al., 2019]. Controlling authorities and food producers are behind consumers' shopping decisions.

A study done in Turkey showed that Turkish consumers' concerns about food additives result mainly from lack of knowledge of food safety in their country. It also showed that participants have misconceptions about food processing techniques and food preservation techniques [Bolek, 2020].

### **G. Study Objectives**

The main objective of this study is to: (i) assess the knowledge, attitudes and practices towards food additives among Lebanese students, (ii) identify association

between socio-demographic factors and food additives, (iii) and identify the association between the KAPs.

## CHAPTER II

### METHODOLOGY

#### **A. Study Setting and Population**

Assessment of people's knowledge, attitudes, and practices was conducted via a descriptive, cross-sectional study among AUB students that are at least 18 years of age.

The intended sample size was calculated using the World Health Organization (WHO) sample size calculator. The level of confidence measured was set at 1.96 (the recommended value for a 95% confidence level), the margin of error (the expected half-width of the confidence interval) at 0.05 and a design effect of 1.5. A representative sample of 250 participants was selected.

#### **B. Recruitment**

The graduate student posted an online invitation (Appendix III) on social media (WhatsApp groups, Instagram, Facebook) where participants were invited to the study. Our target population was AUB students above 18 years old. Interested participants who clicked on the link, had access to the survey (Appendix II). Prior to starting the questionnaire, a consent form (Appendix I) showed on their screen. If they agreed to be part of the research, they would click next, and the survey would launch via AUB Lime survey.

#### **C. Data Collection**

Data collection was done via AUB Lime survey between October and November 2022 and was anonymous. Participants were informed that their participation was completely voluntary and that their refusal to participate would not affect their

relationship with AUB. Participants were also informed that they can ask any questions related to the research in case they needed further clarification.

All members of the research team have CITI Certification for human subjects' research according to AUB IRB regulations before the beginning of the study.

Collected information will be destroyed 5 years after dissemination of the results as per the IRB instructions.

#### **D. Survey Format**

For this study, we used a validated survey. The survey was composed of six sections. The first section included questions related to the participants' socio demographic characteristics such as age, gender, educational level and their income. The second section included questions related to their lifestyle habits and health status. The third section included questions about their food shopping practices. Finally, the last three sections were composed of questions about their practices, knowledge, and attitudes respectively. The completion of the survey took approximately 5-10 minutes.

#### **E. Data Assessment and Interpretation**

Data was collected from October till November 2022. Data were extracted and statistically analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0 (SPSS Inc., Chicago IL, USA). Out of 250 participants who took part of the survey, we had 191 participants with complete responses (67.4% response rate) and 59 participants were excluded from the study for incomplete responses. A knowledge score was created by summing up the number of correct answers for each participant. From the knowledge section in the survey, 5 questions were graded. Participants' responses for these questions were included in the computed scores: "Vitamin E can be

considered as a food additive.” (0-3 points); “Vitamin A (Beta Carotene) is a food additive.” (0-3 points); “Antioxidants are a class of food additives.” (0-3 points), where choosing “disagree” would be the wrong answer; “Control programs and knowledge about food additives are well established in Lebanon.” (0-3 points), where choosing “agree” would be the wrong answer.

Then, we computed each participant’s average response and with a total possible score of 15 correct answers, we considered the median to be the dividing point between a high and a low score. Thus, any score from 0 to 8 to be low and 9 to 15 to be high. Participants' knowledge scores were then used to classify participants with low score and high score.

Descriptive statistics were presented as means and standard deviations (SD) for continuous variables (age of the participants) and as frequencies and proportions for the categorical variables. To analyze the associations between knowledge scores and socio-demographic characteristics (age, gender, education, income...), simple linear regression was conducted. In the regression model, the dependent variable was the knowledge scores, and the independent variables were socio-demographic characteristics (age, gender, education, income ...). A p-value less than 0.05 was considered significant. To analyze the associations between high and low knowledge scores, binary logistic regression was conducted. To analyze the associations between the knowledge, attitudes, and practices scores, correlation analysis was performed.

## CHAPTER III

### RESULTS

A total of 250 participants filled the online survey. After removing those who did not complete the whole survey, 191 participants remained.

#### **A. Socio-demographic Characteristics of Participants**

The socio-demographic characteristics of the participants are found in Table 1. Out of those who completed the survey, 67% of them were females and 33% were males. The majority of the participants were between 18 and 29 years of age(95.3%). Most of them were also single (n=175, 91.6%) and the rest were married. Concerning their education level, 187of them (97.9%) were in college/university. Participants were from different areas in Lebanon where most of them lived in Beirut (n=122, 63.9%) and Mount Lebanon (n=54, 28.3%), and the rest lived in North and South of Lebanon.

As for their employment status, almost half the participants (n=89, 46.6%) were students and the second half were employed or self-employed (n=86, 45.0%), while the rest are unemployed. Regarding their monthly income, 75.8% (n=144) of participants get paid more than 5,000,000 LBP, 15.3% (n=29) get paid between 3,000,001 and 5,000,000 LBP. As for the remaining, their monthly income fluctuates between 675,000 and 3,000,000 LBP.

Characteristics	Study Sample, <i>n</i> (%)
Gender	
Female	128 (67.0)
Male	63 (33.0)
Nationality	
Lebanese	191 (100.0)
Non-Lebanese	
Area of residency	
North Lebanon	4 (2.1)
Mount Lebanon	54 (28.3)
Beirut	122 (63.9)
Bekaa	
South Lebanon	11 (5.8)
Age groups, years	
18-29	182 (95.3)
30-39	8 (4.2)
40-49	
50+	1 (0.5)
Marital Status	
Single	175 (91.6)
Married	15 (7.9)
Widowed	1 (0.5)
Education Level	
Primary school	1 (0.5)
Secondary school	3 (1.6)
College/University	187 (97.9)
Employment Status	
Student	89 (46.6)
Unemployed	16 (8.4)
Employed (or self-employed)	86 (45.0)
Monthly income (in LBP)	
Less than 675,000	2 (1.1)
675,000 – 1,000,000	2 (1.1)
1,000,001 – 1,500,000	1 (0.5)
1,500,001 – 2,000,000	5 (2.6)
2,000,001 – 2,500,000	4 (2.1)
2,500,001 – 3,000,000	3 (1.6)
3,000,001 – 5,000,000	29 (15.3)
Greater than 5,000,000	144 (75.8)

Table 1 Socio-demographic Characteristics

## B. Food Shopping Practices

It was found out that out of 191 participants, 61.8% of them (n=118) did grocery shopping more than 4 times a month. It was also shown that 64.2% of the participants (n=122) frequently purchased packaged or processed foods while 28.4% (n=54) purchased packaged food every time. In terms of what affects their purchasing behavior, price was the highest factor, chosen 71 times, followed by nutrition and brand name, chosen each 34 and 33 times respectively. The least factor they care about is the appearance and the packaging of the product which was chosen only 11 times. Table 2 summarizes the food shopping practices.

Characteristics	Study Sample, <i>n</i> (%)
How many times do you do grocery shopping per month?	
1	15 (7.9)
2	23 (12.0)
3	35 (18.3)
4	
>4	118 (61.8)
How often do you purchase packaged or processed foods?	
Every time	54 (28.4)
Sometimes	122 (64.2)
Never	14 (7.4)
Which of the following affects your purchasing behavior?	
Price	71 (37.2)
Nutrition	34 (17.8)
Brand name	33 (17.3)
Appearance (packaging)	11 (5.8)
List of ingredients	20 (10.5)
Expiry date/best before date	18 (9.4)
Food additives	4 (2.1)

Table 2 Food Shopping Practices

### C. Knowledge of Food Additives

Five questions were used to score the general knowledge of the participants regarding food additives. Many of the participants 120 (62.8%) believe that flavor enhancers, food colorings, and artificial sweeteners are not safe and only 45 (23.6%) of them believe they are.

When they were asked about how vitamins and antioxidants can also be considered additives, the participants were given the chance to have multiple answers (3 answers). For Vitamin E, Vitamin A, and antioxidants the most chosen response was “I don’t know”, chosen by 103 (53.9%) and 95 (49.7%) and 97 (51.1%) participants respectively. As for control programs about food additives in Lebanon, most of the participants 142 (56.8%) believe that they are not well-established while 11 (4.4 %) believe that they are.

When scoring, participants can have a total score of 15. It was shown that 101 (52.9%) received low scores (any score less than or equal to 8). The total knowledge

score had a mean of 7.54 with a standard deviation of 3.116. Total knowledge score was divided into high and low scores as presented in (Table 4).

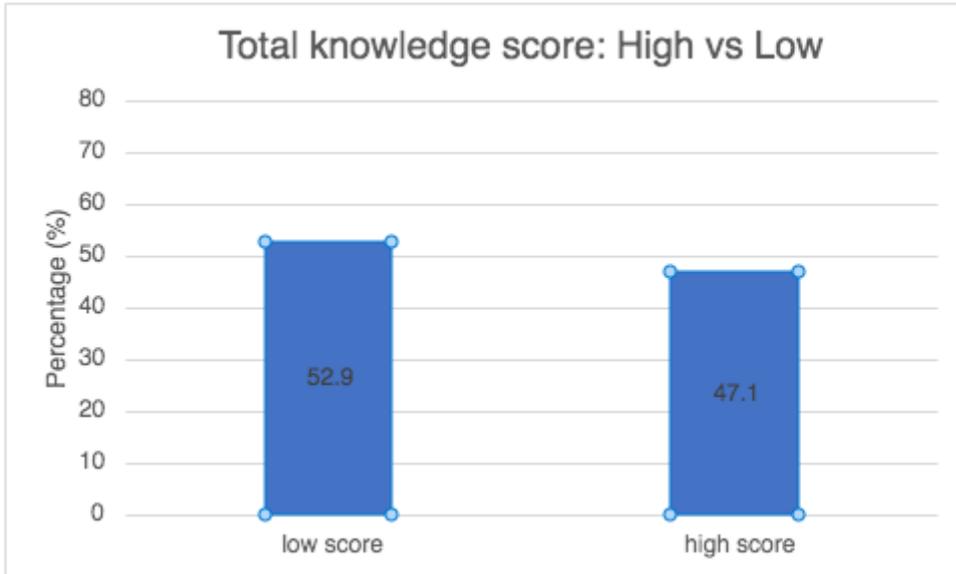


Figure 1 Total Knowledge Score: High vs. Low

Characteristics	Study Sample, <i>n</i> (%)
Vitamin E can be considered a food additive	
Agree	60 (31.4)
Disagree	28 (14.7)
I don't know	103 (53.9)
Vitamin A (Beta Carotene) is a food additive	
Agree	61 (31.9)
Disagree	35 (18.3)
I don't know	95 (49.7)
Antioxidants are a class of food additives	
Agree	57 (30.0)
Disagree	36 (18.9)
I don't know	97 (51.1)
Flavor enhancers, food colorings, and artificial sweeteners are considered safe	
Agree	45 (23.6)
Disagree	120 (62.8)
I don't know	26 (13.6)
Control programs and knowledge about food additives are well-established in Lebanon	
Agree	11 (5.8)
Disagree	140 (73.3)
I don't know	40 (20.9)

Table 3 Knowledge of Food Additives

Characteristics	Study Sample, <i>n</i> (%)	Low Score, <i>n</i> (%)	High Score, <i>n</i> (%)	Sig P-value (0.05%)
Gender				0.283
Female	128 (67.0)	64(50.0)	64 (50.0)	
Male	63 (33.0)	37(58.7)	26 (41.3)	
Nationality				
Lebanese	191 (100.0)			
Area of residency				0.089
North Lebanon	4 (2.1)	1 (25.0)	3 (75.0)	
Mount Lebanon	54 (28.3)	37 (68.5)	17 (31.5)	
Beirut	122 (63.9)	58 (47.5)	64 (52.5)	
Bekaa				
South Lebanon	11 (5.8)	5 (45.5)	6 (54.5)	
Age groups, years				0.435
18-29	182 (95.3)	97 (53.3)	85 (46.7)	
30-39	8 (4.2)	3 (37.5)	5 (62.5)	
40-49				
50+	1 (0.5)	1 (100.0)	0	
Marial Status				0.157
Single	175 (91.6)	89 (50.9)	86 (49.1)	
Married	15 (7.9)	11 (73.3)	4 (26.7)	
Widowed	1 (0.5)	1 (100.0)	0	
Education Level				0.162
Primary school	1 (0.5)	1 (100.0)	0	
Secondary school	3 (1.6)	3 (100.0)	0	
College/University	187 (97.9)	97 (51.9)	90 (48.1)	
Employment Status				0.058
Student	89 (46.6)	44 (49.4)	45 (50.6)	
Unemployed	16 (8.4)	13 (81.3)	3 (18.7)	
Employed (or self-employed)	86 (45.0)	44 (51.2)	42 (48.8)	
Monthly income (in LBP)				0.520
Less than 675,000	2 (1.1)	2 (100.0)	0	
675,000 – 1,000,000	2 (1.1)	0	2 (100.0)	
1,000,001 – 1,500,000	1 (0.5)	1 (100.0)	0	
1,500,001 – 2,000,000	5 (2.6)	3 (60.0)	2 (40.0)	
2,000,001 – 2,500,000	4 (2.1)	3 (75.0)	1 (25.0)	
2,500,001 – 3,000,000	3 (1.6)	2 (66.7)	1 (33.3)	
3,000,001 – 5,000,000	29 (15.3)	15 (51.7)	14 (48.3)	
Greater than 5,000,000	144 (75.8)	74 (51.4)	70 (48.6)	

Table 4High and Low knowledge scores

#### D. Attitudes towards Food Additives

Five questions were used to determine the attitudes towards food additives.

Participants were asked about the role of food additives in the food industry. Most of them, 127 (66.5%) believe that food additives improve the flavor, color and shelf life of foods and 25 (13.1%) of them disagree with this statement while 39 (20.4%) were neutral about it.

When asked about monosodium glutamate, most of the participants, 117 (61.3%) were neutral. Similarly, when asked about the titanium dioxide (E171), 136 (71.2%) were neutral.

Regarding the diet label on soft drinks bottles, 103 (53.9%) of the participants disagreed that the label means it is additive free. 38 of them (19.8%) agreed with this statement. However, 50 of the participants (26.2%) did not have an opinion about this. Regarding the term “no preservatives”, 41 participants (21.5%) disagreed that this term means the food contains additives but no preservatives while 78 (40.9%) agreed with it. 72 participants (37.7%) did not have an opinion about this statement. (Table 5).

Characteristics	Study Sample, <i>n</i> (%)
Food additives improve the flavor, color and shelf life of foods	
Strongly disagree	9 (4.7)
Disagree	16 (8.4)
Neutral	39 (20.4)
Agree	104 (54.5)
Strongly Agree	23 (12.0)
Mono-sodium glutamate (MSG) is used to enhance the flavor of snacks	
Strongly disagree	2 (1.0)
Disagree	9 (4.7)
Neutral	117 (61.3)
Agree	49 (25.7)
Strongly agree	14 (7.3)
The term “diet” on a bottle of soft drink only means it is additive free	
Strongly disagree	38 (19.9)

Disagree	65 (34.0)
Neutral	50 (26.2)
Agree	36 (18.8)
Strongly agree	2 (1.0)
The term “no preservatives” means the food product contains additives but no preservatives	
Strongly disagree	7 (3.7)
Disagree	34 (17.8)
Neutral	72 (37.7)
Agree	71 (37.2)
Strongly agree	7 (3.7)
Titanium dioxide (E171) is considered safe	
Strongly disagree	11 (5.8)
Disagree	36 (18.8)
Neutral	136 (71.2)
Agree	5 (2.6)
Strongly agree	3 (1.6)

Table 5 Attitudes towards Food Additives

### E. Practices towards Food Additives

In order to assess people’s practices towards food additives, three questions were asked. It was shown that out of 191 participants, 69.1% of them (n=132) check the ingredient list sometimes before buying a product and 13.1% of them (n=25) never check it. (Table 6).

On top of that, 50.8% of the respondents (n=97) claimed to be able to identify food additives from the ingredient list whereas 49.2% (n=94) are not able to identify them. (Figure 2)

61.3% of the participants (n=117) are affected sometimes by the presence of food additives in the food product and 26.2% of them (n=50) believe that the presence of food additives does not affect their purchasing behavior. Table 6 below shows all their practices.

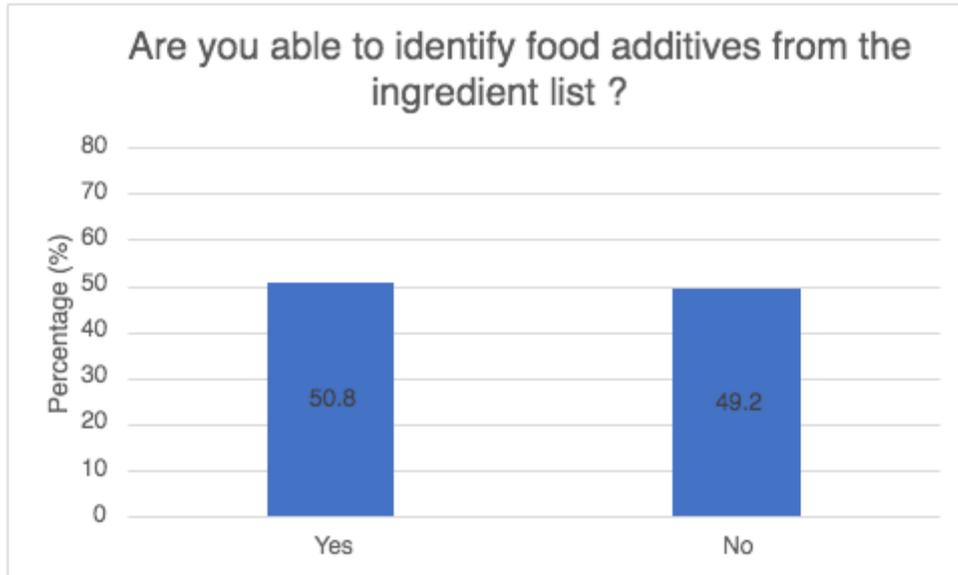


Figure 2 Are you able to identify food additives from the ingredient list?

Characteristics	Study Sample, <i>n</i> (%)
Do you check the ingredient list on food products before purchasing them	
Always	34 (17.8)
Sometimes	132 (69.1)
Never	25 (13.1)
Are you able to identify food additives from the ingredient list	
Yes	97 (50.8)
No	94 (49.2)
Does the presence of a food additive affect your decision to buy the product	
Yes it has an effect	24 (12.6)
Sometimes	117 (61.3)
No, it does not have an effect	50 (26.2)

Table 6 Practices towards Food Additives

### F. Linear Regression results of Knowledge scores

A simple linear regression was performed to see which predictors are associated with the participants' knowledge scores. The predictors are shown in (Table 7). The only characteristic that was found to be significant was the unemployed category ( $\beta = -1.690$ /  $p=0.046$ ).

Further analysis was needed to check whether more predictors are associated with knowledge scores.

Characteristics	Simple Linear Regression B Coefficient, [95% CI] Knowledge Score	Significance P-Value 5% (0.05)
Gender	-0.158 [-1.112, -0.795]	0.744
Area of residency		
North Lebanon	-0.013 [-2.812, 2.787]	0.993
Mount Lebanon	-0.963 [-3.846, 1.920]	0.511
Beirut (Ref)		
Bekaa	-0.022 [-3.448, 3.403]	0.990
South Lebanon		
Age groups, years		
18-29 (ref)		
30-39	0.350 [-1.882, 2.582]	0.757
40-49	0.475 [-5.720, 6.670]	0.880
50+		
Education Level		
Primary school (ref)		
Secondary school	-3.405E-14 [-7.117, 7.117]	1.000
College/University	1.575 [-4.605, 7.755]	0.616
Employment Status		
Student (ref)		
Unemployed	-1.690 [-3.350, -0.030]	0.046*
Employed (or self-employed)	-0.153 [-1.080, 0.774]	0.745
Retired		
Monthly income (in LBP)		
Less than 675,000 (ref)		
675,000 – 1,000,000	5.000 [-0.645, 10.645]	0.082
1,000,001 – 1,500,000	2.000 [-5.140, 9.140]	0.581
1,500,001 – 2,000,000	1.400 [-3.116, 5.916]	0.541
2,000,001 – 2,500,000	2.000 [-2.723, 6.723]	0.404
2,500,001 – 3,000,000	2.667 [-2.382, 7.715]	0.299
3,000,001 – 5,000,000	3.069 [-0.681, 6.819]	0.108
Greater than 5,000,000	2.510 [-1.097, 6.118]	0.171

Table 7 Linear regression of knowledge scores

### G. Logistics Binary Regression of knowledge scores

Logistics Binary Regression was performed to check for other predictors that might be associated with knowledge scores. The predictors were described in (Table 8). No

predictor was found to be significant. Therefore, further analysis was needed to see whether there is an association between knowledge, attitudes, and practices scores.

Characteristics	OR (95% CI)	Significance P-Value 5% (0.05)
<b>Gender</b>		
Female (ref)	1.000	
Male	0.703 (0.382 - 1.293)	0.257
<b>Area of residency</b>		
Beirut (Ref)	1.032	
Outside Beirut	0.638 (0.346 - 1.176)	0.150
<b>Age groups (years)</b>		
18-29 (ref)	0.876	
Above 29	1.426 (0.371 - 5.484)	0.605
<b>Marial Status</b>		
Single (ref)	0.966	
Married	0.345 (0.107 - 1.111)	0.075
<b>Education Level</b>		
College/University (ref)	0.928	
Less than university	0.000	0.999
<b>Employment Status</b>		
Student (ref)	1.023	
Not a student	0.772 (0.436 - 1.366)	0.374
<b>Monthly income (in LBP)</b>		
Less than 3,000,000 (ref)	0.545	
Greater than 3,000,000	1.711 (0.606 - 4.832)	0.311

Table 8 Logistics Binary regression of knowledge scores

## **H. Correlation between knowledge, attitudes and practices towards food additives**

Correlation analysis was then performed in order to check whether the KAPs are related and if there is an association between them. For knowledge and attitudes scores, correlation coefficient  $r$  was  $-0.052$  with a p-value of  $0.478$ . For practice and attitudes scores, correlation coefficient  $r$  was  $0.221$  with a p-value of  $0.002$ . For knowledge and practices scores, correlation coefficient  $r$  was  $0.054$  with a p-value of  $0.460$ . (Table 9) includes all the correlations coefficients as well as the different p-values.

Variables	rho	P-value
Knowledge & Attitude	-0.052	0.478
Knowledge & Practice	0.054	0.460
Attitude & Practice	0.221	0.002*

\* Statistically significant at  $p < 0.05$

Table 9 Correlation between knowledge, attitudes and practices

## CHAPTER IV DISCUSSION

To the best of our knowledge, this is the first study to assess the knowledge, attitudes, and practices of food additives in Lebanon. The results showed that there are no significant associations between socio-demographic characteristics and knowledge. However, we were able to know more about people's shopping habits as well as their attitudes and practices when it comes to choosing products with or without food additives.

The purchasing behavior of 37.2% of participants is affected by the price of the product while 17.3% purchase the product based on the brand name. In our study, only 10.5% would look at the list of ingredients. Comparing our results to a study conducted in 2017, it also showed that the name of the food is the main component shoppers look at while buying a product (93.8%). This study also showed that 59.5% never check the list of ingredients [Hassan, H.F. & Dimassi, H. 2017].

Regarding the total knowledge scores, 101 participants (52.9%) had a low knowledge score while 90 participants (47.1%) had a high knowledge score. It should be noted that even though the number of participants with high knowledge is high, 103 of them (53.9%) didn't know whether vitamin E can be considered as a food additive. Similarly, 95 of them (49.7%) didn't know whether vitamin A could be a food additive and 97 of them (51.1%) didn't know whether antioxidants are a class of food additives. A case treated in Europe has proven the safety of usage of antioxidants (mainly ascorbic acid, Vitamin C) in food products as a food additive [Varvara et al., 2016]. 120 of the participants (62.8%) believed that flavor enhancers, food colorings, and artificial sweeteners are not considered safe while only 45 of the participants (23.6%) believed

that they are safe to consume. Comparing these results with another study done in Turkey, they found that only 3% of the participants indicated that food additives are safe while 74% of the participants said they are not safe to consume [Kayisoglu& Coskun, 2016].

As for the control programs about food additives in Lebanon, most of the participants (n=140, 73.3%) think that they are not well established. These results align with a study done in Europe, where Hungarian participants showed high levels of distrust against the food producers and the controlling authorities [Szucs et al., 2019]. In fact, the level of trust in the authorities and control programs is an important factor in the perception of health risk associated with food additives.

In this study, knowledge scores had no significant difference in terms of the socio-demographic characteristics except for the employment status. The relationship between knowledge score and employment was proven to be statistically significant in the linear regression proving that participants who are unemployed scored less than employed participants. These results closely align with a study done in Iran where the participants' scores showed no significance difference with the demographic specifications ( $p > 0.05$ ) except with the difference in the employment status [Esfahani et al., 2022]. Another study done on students in Sri Lanka showed no significant difference between knowledge and socio-demographic characteristics. [Ekanayake et al., n.d]

Participants showed poor attitudes towards food additives. Although most of them are aware that food additives improve the flavor, color, shelf life of foods, 20.4% of them are neutral when it comes to this topic. On another note, 71.2% of the participants are not aware of the risk of titanium dioxide (E171). In fact, a study on the

controversy of the food additive titanium dioxide (E171) was done after the French decision to suspend the placing of food products containing E171 in the market on the first of January, 2020. It was shown that this food colorant contains nanoparticles that result in negative effects on people's health. [Boutillier et al., 2020] The European Food Safety Authority concluded that titanium dioxide should no longer be considered as a safe food additive. [Blaznik et al., 2021] However, in the Middle East, more specifically in Lebanon, there are no conclusions yet about this additive and based on our study, participants are not familiar with the nature of this additive and the harms associated with it.

50.8% of the participants claimed that they can identify food additives from the ingredient list. Comparing this study to a similar study in Romania, when asked about looking for food additives on food labels, 67.2% of the respondents claimed that they identify food additives in labels. It was thought that this percentage seems inaccurate due to the fact that the consumer spends 5-6 seconds on average before deciding to buy a product or not. [Zugravu et al., 2016] Also, based on this study, and based on the participants' knowledge scores and whether they are familiar with a series of food additives (MSG, E171, Vitamin C ...), it showed that they are not as knowledgeable in this topic as they claim to be.

The presence of food additives affects the decision of 61.3% of the participants to buy a product. In a study conducted in Romania in 2016 on attitudes towards food additives, they concluded that two thirds of the respondents do not agree with the use of food additives and that they prefer buying foods without additives. [Zugravu et al., 2016]

As for the association between knowledge, attitudes, and practices scores, a weak positive correlation was observed between attitudes and practices and this appeared to be highly significant ( $r=0.2$ ,  $p<0.05$ ). This is explained by having positive attitudes results in good practices.

One of the limitations of this study is that it is online. The respondents are not monitored thus they can search for the right answer or use external assistance (information bias). Also, most participants were focused mainly in Beirut area (selections bias). Another major limitation is the sample population size because of non-responses and incomplete surveys.

## CHAPTER V

### CONCLUSION AND RECOMMENDATION

Food additives that are reported as safe cause no harm to consumers. “Without food additives, it would be impossible to maintain the high standards of security, selection and convenience in our food supply”. [Kayisoglu & Coskun, 2016]

Knowledge is indispensable for people to be aware of what is present in their food products. Consumers have the right to be informed about the presence of food additives and be able to identify between them. In Lebanon, we do not have enough trust in our food supply caused by the lack of trust in our food safety. Several studies have shown the importance of trust in regulators in the acceptance of food additives. Food additives have existed for decades and are irreplaceable in food technology. Awareness is crucial in making this topic more prevalent especially since banned and permitted food additives are updated frequently. The Lebanese market must follow the latest updates when it comes to these chemicals for the sake of the safety of the consumers. More knowledge about food additives is required to target people’s attitudes towards them to mainly shift them from the perception “that synthetic equals dangerous”. [Zugravu et al., 2016] Workshops must be conducted in schools and universities on this topic to inform people which food additives are safe to consume.

Future studies must be conducted to learn more about the perception of Lebanese students towards the government and food safety systems in Lebanon and know their opinions about its impact on people’s risk perception of food additives.

# APPENDIX I

## CONSENT FORM

Dear Participant,

You are invited to participate in a research study entitled “Knowledge, Attitudes and Practices (KAPs) towards Food Additives among Lebanese population.”

This study is conducted by Dr. Samer Kharroubi, Department of Nutrition and Food Sciences, American University of Beirut. The main objective of this study is to investigate the knowledge, attitudes, and practices of the Lebanese population towards food additives.

This message invites you to read the consent document and consider whether you want to be involved in the study.

And to note that:

- This is not an official message from AUB
- Participation is completely voluntary
- This study will include a sample of 700 people from different Lebanese governorates.
- The recruitment of the participants will be through online surveys
- Completing the questionnaire will take around 5-10 minutes
- Only the data you provide in the questionnaire will be collected and analyzed.
- The survey is anonymous and there are no personal or identifying information.
- The research team does not have access to your name or contact details
- Data collected will be monitored and may be audited by the IRB while assuring confidentiality
- You may download the consent form if you wish to keep a copy

### **POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

No direct benefits are expected, however findings from the present study will identify gaps to improve knowledge and attitude about food additives to select healthier food and prevent food safety issues among Lebanese adult population. Findings from the present study will help identify necessary education and training in terms of food additives as well as food labels in order to prevent misinterpretations regarding food additives.

### **POTENTIAL RISKS TO SUBJECTS AND/OR SOCIETY**

The risks of the study are minimal and your participation in this survey does not involve any distress.

### **CONFIDENTIALITY**

The collected data will remain confidential and anonymous. It will be stored on the PI's password-protected computer, and only the research team would have access to it. Data will be monitored and may be audited by the IRB while assuring confidentiality.

We will be using the information collected from the surveys for our master's thesis project, which is a requirement for our degree at the Department of Nutrition and Food Sciences. Findings from this study will be used for research purposes only.

### **PARTICIPATION AND WITHDRAWAL**

If you voluntarily consent to take part in this study, you can change your mind and withdraw at any time without consequences of any kind. Refusal to participate in the

study will involve no penalty or loss of benefits to which you are otherwise entitled. Also, your refusal to take part in the study will not affect your relationship with AUB.

**QUESTIONS ABOUT THE STUDY**

If you have any questions or concerns about the study, you can contact Dr. Samer Kharroubi at [sk157@aub.edu.lb](mailto:sk157@aub.edu.lb)

**CONCERNS OR QUESTIONS ABOUT YOUR RIGHTS**

If you have concerns about the study or questions about your rights as a participant, you can contact the American University of Beirut (AUB) Social and Behavioral Institutional Review Board (IRB) at [irb@aub.edu.lb](mailto:irb@aub.edu.lb) or AUB extension: 5445.

**ACCESS TO THE SURVEY**

If after reading the consent document and having your questions answered, you voluntarily agree to take part in the study, you can access the survey by answering the questions below.

## APPENDIX II

### QUESTIONNAIRE

#### **Socio-Demographic Characteristic**

- 1- Gender
  - a. Male
  - b. Female
  
- 2- Nationality
  - a. Lebanese
  - b. Non-Lebanese
  
- 3- If Lebanese, in which area do you currently live?
  - a. North Lebanon
  - b. Mount Lebanon
  - c. Beirut
  - d. Bekaa
  - e. South Lebanon
  
- 4- Age group
  - a. 18-29
  - b. 30-39
  - c. 40-49
  - d. 50+
  
- 5- Marital status
  - a. Single
  - b. Married
  - c. Divorced
  - d. Widowed
  
- 6- Area of residency
  - a. Beirut
  - b. Mount Lebanon
  - c. North
  - d. South
  - e. Bekaa
  
- 7- Educational level
  - a. Primary school
  - b. Secondary school
  - c. College/university
  - d. No formal education
  
- 8- Employment status
  - a. Student
  - b. Unemployed

- c. Employed (or self-employed)
- 9- Specify the household monthly income (portion in LBP)
  - a. Less than 675,000
  - b. 675,000 – 1,000,000
  - c. 1,000,001 – 1,500,000
  - d. 1,500,001 – 2,000,000
  - e. 2,000,001 – 2,500,000
  - f. 2,500,001 – 3,000,000
  - g. 3,000,001 – 5,000,000
  - h. Greater than 5,000,000

### **Lifestyle Habits/ Health Status**

- 10- Do you consider yourself health conscious in general?
  - a. Yes
  - b. No
- 11- Are you following a prescribed diet?
  - a. Yes
  - b. No, please skip questions 12-15
- 12- How long have you been on this diet regimen?
- 13- What is the source of the diet prescription?
  - a. Dietitian
  - b. Self-prescription
  - c. Friends or relatives
- 14- What is the reason behind following a diet?
  - a. Weight management
  - b. Disease condition
  - c. Prevention of chronic diseases (CVD, diabetes, cancer ...)
- 15- How do you describe the impact of following a diet?
  - a. Weight loss
  - b. No change
  - c. Maintenance
- 16- Do you suffer from any chronic disease?
  - a. No
  - b. Yes, please specify
- 17- Do you suffer from any of the following problems?
  - a. Bloating
  - b. Diarrhea
  - c. Constipation
  - d. Nausea
  - e. Reflux

f. No, I don't suffer from any of these problems

18- Have you or any of your relatives ever experienced one of these reactions after consuming packaged food?

- a. Digestive disorders (diarrhea, pain)
- b. Nervous disorders (hyperactivity, insomnia, irritability)
- c. Respiratory problems (asthma, rhinitis, and sinusitis)
- d. Skin problems (itching, rashes, and swelling)

### **Food Shopping Practices**

19- How many times do you do grocery shopping per month?

- a. 1
- b. 2
- c. 3
- d. 4
- e. >4

20- How often do you purchase packaged or processed foods during grocery shopping?

- a. Every time
- b. Sometimes
- c. Never

21- Which of the following affect your purchasing behavior?

- a. Price
- b. Nutrition
- c. Brand name
- d. Appearance (packaging)
- e. List of ingredients
- f. Expiry date/best before date
- g. Food additives

### **Food Additives: Knowledge**

22- Vitamin E can be considered as a food additive.

- a. Agree
- b. Disagree
- c. I don't know

23- Vitamin A (Beta Carotene) is a food additive.

- a. Agree
- b. Disagree
- c. I don't know

24- Antioxidants are a class of food additives.

- a. Agree
- b. Disagree

c. I don't know

25- Flavor enhancers, food colorings, and artificial sweeteners are considered safe.

- a. Agree
- b. Disagree
- c. I don't know

26- Control programs and knowledge about food additives are well-established in Lebanon?

- a. Agree
- b. Disagree
- c. I don't know

**Food Additives: Attitudes**

27- To what extent do you agree or disagree with the following statements:

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Food additives improve the flavor, color and shelf life of foods					
Mono-sodium glutamate (MSG) is used to enhance the flavor of snacks					
The term "diet" on a bottle of soft drink only means it is additive free					
The term "no preservatives" means the food product contains additives but not preservatives					
Titanium dioxide					

(E171) is considered safe					
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**Food Additives: Practices**

28- Do you check the ingredient list on food products before purchasing them?

- a. Always
- b. Sometimes
- c. Never

29- Are you able to identify food additives from the ingredient list?

- a. Yes
- b. No

30- Does the presence of a food additive affect your decision to buy the product?

- a. Yes, it has an effect
- b. Sometimes
- c. No, it does not have an effect

## APPENDIX III

INVITATION SCRIPT  
AUB Social & Behavioral Sciences  
INVITATION SCRIPT

**Invitation to Participate in a Research Study**

This notice is for an AUB-IRB Approved Research Study for Dr. Samer Kharroubi at AUB. (Phone: (01) 350 000 Ext: 4541)

(Email: [sk157@aub.edu.lb](mailto:sk157@aub.edu.lb))

**\*It is not an Official Message from AUB\***

I am inviting you to participate in a research study about “Knowledge, Attitudes and Practices (KAPs) towards Food Additives among Lebanese population.”

You will be asked to complete a short survey/questionnaire with demographic information

You are invited because we are targeting Lebanese adults who are either households or frequent consumers of packaged and processed foods.

The estimated time to complete this survey is approximately 5-10 minutes

The research is conducted via an online survey filled by Lebanese people

Please read the consent form and consider whether you want to be involved in the study

If you have any questions about this study, you may contact the investigator/research team (Yara Thamine, 71945144, [yat05@mail.aub.edu](mailto:yat05@mail.aub.edu))

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