AMERICAN UNIVERSITY OF BEIRUT

KNOWLEDGE, ATTITUDES AND PRACTICES (KAPS) REGARDING FOOD ADULTERATION: A NATIONAL CROSS-SECTIONAL STUDY IN LEBANON

by
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ABSTRACT

OF THE THESIS OF

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Major: Food Technology

Title: Knowledge, Attitudes and Practices (KAPS) regarding food adulteration: A national cross-sectional study in Lebanon

Introduction: Food adulteration is a crime involving the selling of impure foods which do not conform to basic food standards. There are different ways of adulteration food and plenty of substances are used to adulterate the food, aka adulterants. Objective: The objective of this study is to 1) investigate the knowledge, attitudes, and practices of Lebanese adults towards food adulteration, and 2) identify factors associated with food adulteration. Methods: A descriptive cross-sectional study was conducted online among Lebanese citizens or residents of Lebanon that are at least 18 years of age. The online survey was shared in social media, such as WhatsApp, Instagram, Facebook, and Twitter). Results: Amongst 499 participants, 73.1% had a low knowledge score and 26.9% had a high knowledge score. Participants with undergraduate degrees had higher scores than those only with a high school diploma and ones with master's degree had higher scores than both. People aged 30-39 had better knowledge than those aged 18-29. The participants who are still students had lower scores than the ones who are employed. The relationship between knowledge score and employment also proved to be statistically significant (with a p-value < 0.05) in the multiple regression proving that students had lower scores than employed participants. Conclusion: Food adulteration is a global problem and spreading awareness is the first step to start decreasing it. More future studies must be conducted.

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CHAPTER I

INTRODUCTION

Food adulteration is a crime involving the selling of impure foods which do not conform to basic food standards. It is referred to as a “silent genocide” and according to the UK Food Standard Agency (FSA) it is defined as “deliberately placing food on the market, for financial gain, with the intention of deceiving the consumer” [Elliot Review]. Economically, the food manufacturers will have an increase in their profits. However, the health outcomes of these food frauds could be drastic which vary from minor sicknesses such as gastrointestinal diseases (vomiting and diarrhea) to major diseases such as cancer or even death.

A. Methods and Types of Food Adulteration

Food adulteration can be done in various ways. The first way is by adding extraneous matter, such as adding chalk to powdered milk or adding lead to turmeric. The second is by mixing inferior quality with superior quality, this is commonly found in honey which is mixed with sugar syrup. Also, adding illegal preservatives and coloring dyes, such as coloring wine or spices. Another way is when companies remove vital ingredients, such as removing fat from milk.

In 2015, the Administration Assistance and Cooperation System for Food Fraud (AAC- FF) was created in order to allow the countries in the EU and specifically “the members of the EU- Food Fraud Network to communicate information on non-compliances and potential intentional violations of the EU agri-food chain legislation”. The AAC- FF classified the methods of food adulteration into 4 more different ways

which include mislabeling, replacement/ dilution/removal of product, unapproved treatment or process, absent/ falsified or manipulated documents and finally, Intellectual Property Rights (IPR) infringement. [The EU Food Fraud Network ,2019]

On top of the various ways of adulterating food, there are also different types of adulterants. For simplification, the types are divided into 3 parts. First is intentional adulterants which may cause harm to the body physically and medically such as chalk powder, mud, pebbles, mineral oil and others. Second is metallic contamination which are pesticides, lead, mercury, tin and so on. The final type is incidental adulterants which are pesticide residues, dropping of rodents on tin in canned foods and larvae in food [Nidhi, G., Priti, P. 2009].

B. Prevalence of Food Adulteration

In Lebanon, a study evaluating the gluten contamination in 173 (GF)- labeled food products found that 19% of the total samples were found to be mislabeled [Hassan, H. et al. 2017]. On July 22nd, 2020, the Minister of Public Health discovered that Lebanese Poultry Company have been supplying supermarkets, and restaurants with expired products, some dating back 4 years, and disguising them as chicken nuggets and burger patties as well as changing their expiration dates. Analysis of 44 recent studies of more than 9,000 seafood samples from different sources and more than 30 countries from Europe, Asia and America, revealed that 36% were mislabeled. Many low-value fish were labeled as high- value fish and some were substituted with similar species. Shockingly, some samples proved not to be entirely of aquatic species. In Singapore, prawn balls were found to contain pork instead of prawn. [The Guardian, 2021]. In India, Wardha District, it was found that 73% of cloves and 61% of tea were found to

be adulterated [Chaudary, S et al. 2011]. In Bangladesh, Dhaka City, 73% of the juices failed to conform to the standards set by the Bangladesh Standards and Testing Institute (BTSI), with most of them having incorrect production and expiration dates. On top of that, out of 62 salt samples, 87% of them did not conform to the standard levels of pH, iodine, chlorine, and moisture levels [Nasreen, S. et al. 2014]. In Poland, 146 alerts under the hazard category "composition" were found from 1996 till 2018. Unauthorized usage of colorants such as Sudan 1 and Rhodamine B as well as high content of aluminum were mainly found in rice, pasta, rice products and noodles (74%) and the rest being cereal, bread, flour, cake/cake mixes, spelt and frozen pastry [Aleksandra, K. et al. 2018]. The famous milk scandal in China in 2008 involved the adulteration of infant formula and powdered milk with the poisonous melamine which caused over 6,240 cases of kidney stones in children and three deaths [World Health Organization, 2008]. In total, 47 countries received melamine-contaminated products, as reported to INFOSAN or published on each country's official government web site, either through direct import or through third countries [Gossner, C. et al. 2009]. On top of that, the addition of melamine was also found in 2008 in Poland in a wheat-based snack called Salty Sticks [Aleksandra, K. et al. 2018].

According to the 2019 Annual Report of the AAC-FF, in Europe 'Fats and Oils' was the most notified adulterated food category (mainly olive oil). Second highest was found to be 'Fish and Fish Products' and third was 'Meat and Meat Products'. [The EU Food Fraud Network].

C. Knowledge on Food Adulteration

Knowledge is crucial for the consumer to protect themselves and their families against these frauds. In India, Karnataka, it was found that amongst 75 participants, only 21% had good knowledge, 60% had average knowledge and the remaining 19% had no knowledge. Also, they concluded that the higher the education, the more aware they were of the topic and people ages 25-50 years old had a better knowledge than those over the age of 50 [Abidfaheem, K. et al. 2013]. In India, Wardha District, they found that the purity of food was highest amongst 'literate' (72.2% pure foods) followed by 'just literate' (47.5% pure foods) and lowest purity was found in homes of 'illiterate' participants (30.2% pure foods) [Chaudary, S. et al. 2011]. In 2017, the knowledge and behaviors of the Lebanese population towards honey was studied since honey is one of the most popular adulterated foods. They found that around 50% of the participants checked if the honey was adulterated and 75% claimed to know a couple of adulteration methods; even though there are more than 10 different methods to adulterate honey [Addam, K. et al. 2017]. In Lebanon, local honey is priced higher than imported and 91% of Lebanese participants were not attracted to low priced honey, they believed that if the honey is placed at a high price, then it is "safe". However, imported honey goes through several ISO testing whereas the local honey is not tested [Addam, K. et al. 2017].]. No other study regarding the knowledge of the Lebanese population on food adulteration has been conducted.

D. Role of the Governments

Adulteration is a global problem, and it is the responsibility of each country's governments to undergo random testing of all sold foods and implement laws in order to

reduce the prevalence of unsafe adulterated foods being sold. Countries must work together to try to reduce food fraud as much as possible.

In 2018, UK sent a request to notify Spain that the Saffron that has been imported from there might be adulterated. After sampling, it was found that saffron was being mixed with other materials that are not considered food products. As a result, with the help of UK, the Spaniards were able to locate the source of this adulterated saffron as well as seized a total of 87kg of adulterated saffron [The EU Food Fraud Network, 2019].

The EU Food Fraud took part in Operation OPSON; which is a joint Interpol/ Europol initiative where they target food adulteration. 16 EU member states and 18 Non-EU member states (including UAE and Egypt) joined in this initiative. The operation acted upon 3 targets. The first target was the mislabeling of organic foods where over 775 tons of adulterated/ counterfeit organic foods were detected to be non-organic in 2019. The second target was on the adulteration of pure Arabica coffee where the Arabica coffee was found to be replaced with a cheaper bean called Robusta. It was found that out of 400 coffee samples, 10 of them were adulterated which caused the launching of further and deeper investigations. Their third target was on 2-Dinitrophenol (DNP) which is a chemical that is used for explosives and pesticides. ‘Diet pills’ also used this chemical because of its ability to cause rapid weight loss however it was banned because it caused seizures and even deaths. Since they are illegal to be sold, they are found online. Through the operation more than 75 websites were tracked down and stopped.

E. Law in Lebanon

A law regarding food adulteration is stated by the Lebanese parliament under the Consumer Protection Law Article 109:" *Shall be punished by imprisonment from three months to one year and by a fine varying from LBP 25 to 50 million, whoever knowingly commits the following acts:*

- *To adulterate ingredients of human and animal foods, or pharmaceuticals products, or drinks or industrial, agricultural or natural products.*
- *To trade in or circulate spoiled, polluted or expired foodstuffs.*
- *To possess products or foodstuffs of the kind prescribed in the above clauses* (Article 109, 2004)". [Consumer Protection Law, 2004]

F. Study Objectives

The main objective of this study is to: (i) investigate the knowledge, attitudes and practices of the Lebanese population towards food adulteration, (ii) and identify factors, demographic characteristics for example, associated with food adulteration

CHAPTER II

METHODOLOGY

A. Study Population

A descriptive cross-sectional study was conducted online among Lebanese citizens or residents of Lebanon that are at least 18 years of age after a pilot study with 15 participants was conducted. Each of the participant's identity was completely anonymous; no name or any other personal information was recorded. The information collected from the survey was used for research purposes only and the data has been kept strictly confidential and stored on the PI's password protected computer. Due to the current COVID-19 pandemic, the survey was conducted online and shared on social media.

For our sample size, we set the level of confidence measure at 1.96 with a recommended value for a 95% confidence level, the margin of error or the expected half-width of the confidence interval at 0.05, the design effect at 1.5 and a response distribution of 80%; where we obtained a representative sample of 720 participants. The sample size was calculated using the WHO sample size calculator [World Health Organization. NCDS sample size calculator], available on the following link: www.who.int/ncds/surveillance/steps/resources/sample _size_calculator.xls

B. Data Collection

All students' researchers and other members of the research team have CITI certification for human subjects' research according to AUB IRB regulations prior the initiation of the study or a research ethics training and certificate. An online invitation

(Appendix III) was out via social media (WhatsApp groups, Facebook pages, Instagram, and Twitter). Before starting the survey, a consent form appeared on their screen (Appendix I) and after they agreed to take part in the study, they filled in the survey. The completion of the survey should take approximately 5-10 minutes (Appendix II)

C. Survey Format

The survey was developed to evaluate the knowledge, attitudes, and practices towards food adulteration. The survey is based on previous similar studies (Nasreen & Ahmed, 2014; Abidfaheem, et al., 2013; Nidhi & Priti, 2009**)** and was split into three sections. The first section included questions related to their sociodemographic characteristics such as age, gender, relationship status, area of residency, educational level, employment status and the total amount of income. The second section is composed of 7 questions related to their buying and consuming practices. It included questions on who buys the groceries and what they look out for before buying or consuming a product. On top of that it tackles their attitudes towards labeled and branded compared to nonlabelled and non-branded products as well as their trust towards the products. The last section included 9 questions testing their knowledge on food adulteration. It comprised of 4 multiple choice and 2 yes/no questions about food adulteration and 3 questions relating to their opinions on the Lebanese law and its reinforcement.

D. Data Assessment and Analysis

After a month of keeping the survey online , from January until February 2021, the results of the participants were placed into an excel sheet where out of 561 participants, 62 of them were removed from the data sheet leaving us with 499 participants. The participants who stopped the survey halfway were disregarded. A knowledge score for each participant was created where we tallied the number of correct answers. From the Knowledge Section of the survey, 3 questions were graded:

- Question 1: 'How is food adulterated?' was graded out of 6 since the question has 6 answers
- Question 3: 'Which substance(s) do you believe can be considered adulterants?' was also graded out of 6
- Question 6: 'Which foods do you believe can be adulterated?' was graded out of 8 since the question has 8 answers

Then, we computed each participant's average response and with a total possible score of 20 correct answers, we considered the mode to be the dividing point between a high and low score. Hence, any score from 0 to 10 to be low and 11 to 20 to be high. The results obtained were statistically analyzed using the Statistical Package for the Social Sciences (SPSS) version 25.0. Descriptive statistics is presented as means and standard deviations (SD) for the age of the participants (continuous variables) and as frequencies and proportions for the categorical variables. For the analysis of the associations between our knowledge score and sociodemographic characteristics (gender, age, education and so on), simple linear regression followed by multiple linear regression was conducted. In the regression model, the knowledge score was used as the dependent variable and sociodemographic characteristics (gender, age, education and so

on) were all used as as independent variables A p-value of less than 0.05 was considered to be significant.

CHAPTER III
RESULTS

A total of 561 participants filled in the online survey. However, after removing the participants who did not continue the survey until the end, 499 participants remained.

A. Sociodemographic Characteristics of Participants

All the sociodemographic characteristics are found in Table 1. Out of these 499, 40.3% of them were females and remaining 59.7% were males. The ages ranged between 18 and 71 with a median of 25.0 (mean = 26.4 ± 8.7 and). The majority of the participants were single (n=415, 83.2%) and the remaining were married. As for their highest received education level, 74 (14.8%) had a high school diploma, 260 (52.1%) had an undergraduate (bachelors) degree, 147 (29.5%) had a master's degree and 18 (3.6%) had a PhD. Most of the participants live in Mount Lebanon (n=303, 60.7%) and Beirut (n= 142, 28.5%) and the remaining were in Beqaa, North and South.

Regarding employment, approximately 43.1% (n=215) of participants had a full-time job, 12% (n=60) have a part-time job, 28.7% are still studying without working (n=143) and 15.6% (n=78) are either seeking employment or unemployed. At the time of the online survey, the dollar was fluctuating between 5,000 – 7,000 LBP. Around 39.7% (n=198) receive a total monthly income of more than 5,000,000 LBP, 28.3% (n=141) receive 1,000,000 -3,000,000 LBP, 20.4% (n=102) receive 3,000,0000-5,000,000 LBP and 9.2% (n=46) receive less than 1,000,000LBP.

Table 1 Sociodemographic Characteristics of the respondents

Characteristics	**Total Sample N=499 (%)**
Gender	
Female	298 (59.7)
Male	201 (40.3)
Median (range) age in years	25.0 (18 - 71)
Marital Status	
Single	415 (83.2)
Married	84 (16.8)
Area of Residency	
Beirut	142 (28.5)
Mount Lebanon	303 (60.7)
South	15 (3.0)
North	20 (4.0)
Beqaa	19 (3.8)
Education Level	
High School Diploma	74 (14.8)
Undergraduate (Bachelor's Degree)	260 (52.1)
Master's degree	147 (29.5)
PhD	18 (3.6)
Employment Status	
Employed (Full Time)	215 (43.1)
Employed (Part Time)	60 (12.0)
Actively Seeking employment	39 (7.8)
Unemployed / Stay at home parent	39 (7.8)
Student	143 (28.7)
Retired	3 (0.6)
Total Income	
< 1,000,000 LBP	46 (9.2)
1,000,000-3,000,000 LBP	141 (28.3)
3,000,000-5,000,000 LBP	102 (20.4)
> 5,000,000 LBP	198 (39.7)

B. Buying Practices

It was shown that out of 499 participants, 62.3% of them (n=311) read the food labels before buying and consuming them. Those 311 participants were then given a list of what they read on the label to choose from: the main ones were ingredients which was chosen 208 times and nutrition facts sheet which was chosen 169 times. The least factor they read is the food additives, chosen 65 times, and the health claims, chosen 60 times. On top of that, when buying any product, the participants showed that they

mainly focus on the expiry date, where it was chosen 408 times, and on the price of the product, where it was chosen 382 times. Table 2 concludes all the buying practices.

Table 2 Buying practices of the participants

Characteristics	**Total Sample N=499 (%)**
Who is responsible for buying the groceries at home	
Myself	166 (33.3)
Parents	298 (59.7)
Spouse	35 (7.0)
Do you read food labels before buying / consuming any product	
Yes	311 (62.3)
No	188 (37.7)
What is your focus (N=311) *	
Ingredients	208 (41.7)
Nutrition Fact Sheet	169(33.9)
Just Calories	76 (15.2)
Storage instructions	73 (14.6)
Addition of food additives	65 (13.0)
Nutrition Claims	101 (20.2)
Health Claims	60 (12.0)
Criteria for buying /consuming any food product *	
Expiry Date	408 (81.8)
Price	382 (76.6)
Brand	344 (68.9)
Appearance of package	156 (31.3)
Local products	107 (21.4)
Imported products	55 (11.0)

*Multiple Responses

C. Attitudes towards food products

When asked whether the consumer buys mainly branded or unbranded products 81% chose branded (n= 404) however only 18.4% (n=92) claimed that they never buy any product that is unbranded. The most common unbranded items were found to be olive oil (65.1%) and honey (58.7%), the remaining claimed to buy unbranded rice, molasses and dairy products. As for trusting labels, the participants mainly ‘trust the labels completely’ (n=194, 38.9%) and ‘only trust labels on imported brands’ (n=183,

36.7%). The remaining 110 participants (22%) do not trust the labels at all and only 12 participants (2.4%) only trust local brands. (Table 3)

Regarding the Lebanese laws, 66.9% of the participants believed that Lebanon does not have a law against food adulteration, with only 165 (33.1%) believing that there is a law. Nonetheless, out of those 165, only 12 (2.4%) believe that the law is being followed. Moreover, 229 participants (45.9%) believe that the rate of food fraud in Lebanon is high. (Table 3).

Table 3 Knowledge and Attitudes towards products and the Lebanese laws

Characteristics	**Total Sample N=499 (%)**
Do you mainly buy/ consume branded or unbranded products	
Branded	404 (81.0)
Unbranded	95 (19.0)
What unbranded products do you consume	
Honey	293 (58.7)
Olive oil	325 (65.1)
Rice	80 (16.0)
Molasses	147 (29.5)
I never buy unbranded	92 (18.4)
Do you trust the labels on the packages	
Yes, I trust them completely	194 (38.9)
I only trust labels on imported brands	183 (36.7)
I only trust labels on local brands	12 (2.4)
I do not trust the labels	110 (22.0)
Does Lebanon have a law against food adulteration	
Yes	165 (33.1)
No	334 (66.9)
Do you believe it is being followed (N=165)	
Yes	12 (2.4)
No	151 (30.3)
N/A	2 (0.4)
The level of food adulteration in Lebanon	
Low	59 (11.8)
Moderate, can happen with foods of low cost	211(42.3)
High	229 (45.9)

D. Knowledge on Food Adulteration

Three main questions were used to score and determine the general knowledge of the participants regarding the topic. (Table 4). Most of the participants, 384 (77.0%) do believe that food adulteration can affect the health and 101 (20.2%) of them did not know the answer.

When asked how food is adulterated, the participants were given the chance to have multiple responses. Out of 6 answers only 1 of them is wrong: “rotten bread” and that answer was the most popular one where it was chosen 355 times (71.1%). The least one was the mislabeling option: “claiming milk is lactose free although it is not” where it was chosen only 173 times (34.7%). (Figure 1). As for adulterants, the most chosen one was “illegal colorants and preserves” with 262 choices and the least were urea and pebbles, each having 71 choices (14.2% each). (Figure 2). Concerning the foods that can be adulterated, rice was found to be the least chosen one with 97 choices (19.4%) whereas chicken, meats and meat products were found to have the most, 297 (59.5%).

When scoring, any participant can have a total score of 20. It was found that 365 (73.1%) received low scores (any score less than or equal to 10). The total knowledge score had a mean of 7.74 with a standard deviation of 4.49. (figure 3).

Figure 1 How is Food Adulterated?

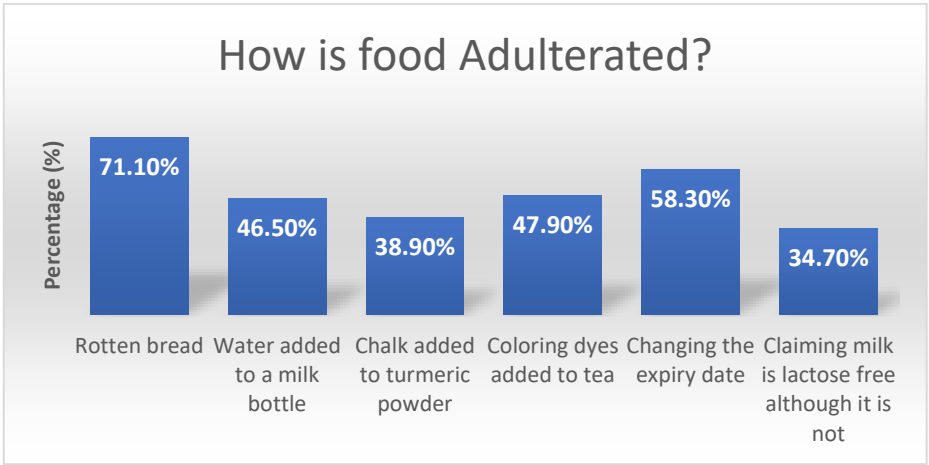

Figure 2 Which substances can be considered adulterants?

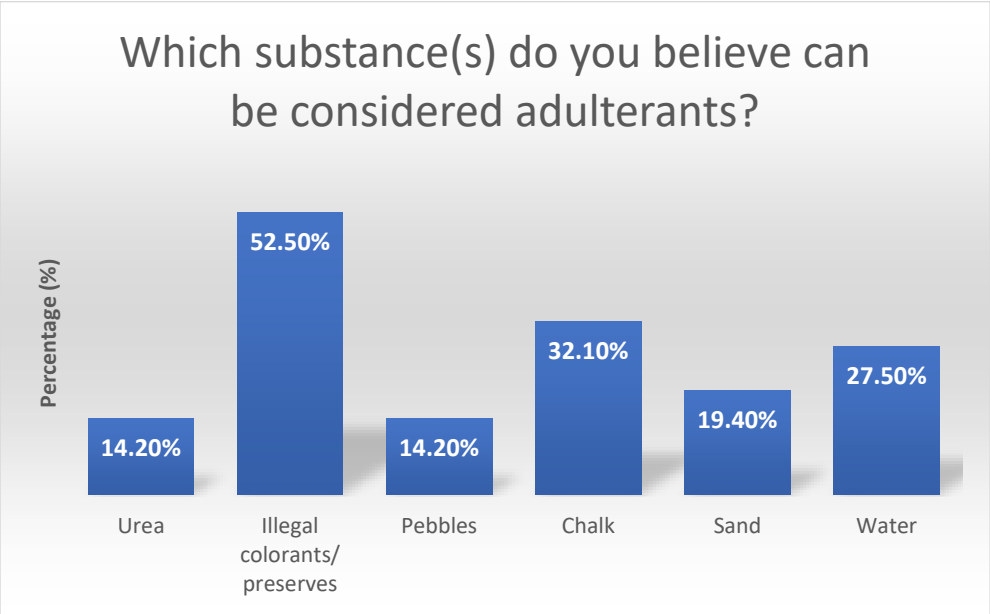

Figure 3 Total Knowledge Score: High vs. Low

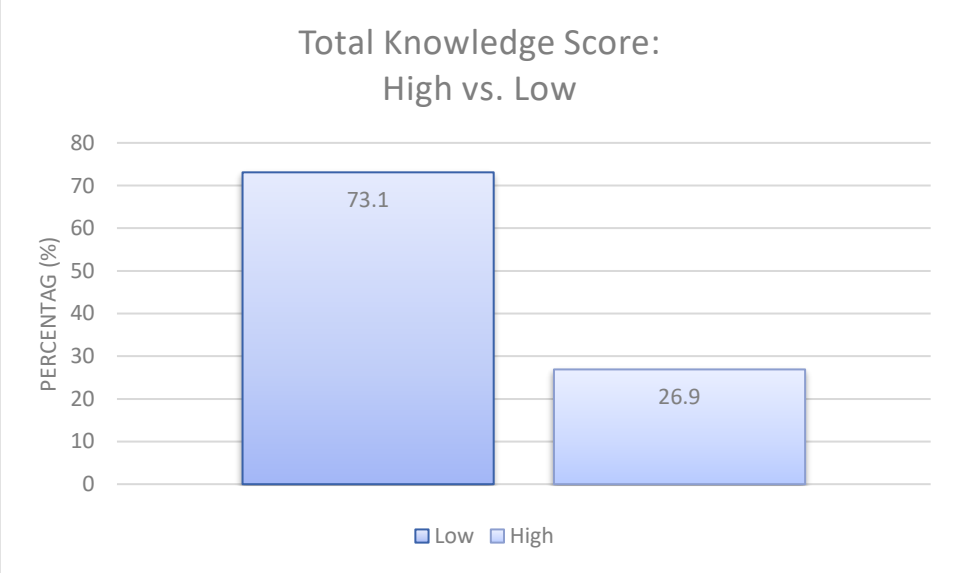

Table 4 Knowledge of Food Adulteration of the respondents

Knowledge	**Total Sample N=499 (%)**
How food is adulterated*	
Rotten bread	355 (71.1)
Water added to a milk bottle	232 (46.5)
Chalk added to Spices	194 (38.9)
Adding Coloring dyes	239 (47.9)
Changing the expiry date	291 (58.3)
False claims	173 (34.7)
Common Adulterants*	
Urea	71 (14.2)
Illegal colorants and preserves	262 (52.5)
Pebbles	71 (14.2)
Chalk	160 (32.1)
Sand	97 (19.4)
Water	137 (27.5)
Food items that can be adulterated*	
Fruits and Vegetables	133 (26.7)
Flour, wheat and bakery products	252 (50.5)
Chicken, Meats and meat products	297 (59.5)
Juices	255 (51.1)
Milk	261 (52.3)
Spices	174 (34.9)
Salt and sugar	121 (24.2)
Rice	97 (19.4)
Can adulteration effect health	
Yes	384 (77.0)
No	14 (2.8)
I do not know	101 (20.2)
Total Knowledge Score (Mean ± SD)	7.74 ± 4.49

*Multiple Responses

E. Linear Regression Results of Knowledge Scores

A simple linear regression identified 6 predictors that were significantly associated with the participants' knowledge scores. All the predictors are described in (Table 5). The ones found significant are gender (β=-0.900/p = 0.031), ages 30-39 (β=1.368/p=0.048), marital status (β=1.096/ p=0.041), undergraduate degree (β= 1.376/ p=0.020), master's degree (β=1.256/p = 0.049), and students (β =-1.061, p=0.028).

All significant predictors obtained from simple regression were analyzed by multiple linear regression where one predictor was found to be significantly associated with knowledge scores. Participants who are no longer students have a higher knowledge score than the participants who are still students.

Table 5 Simple Linear Regression

Predictors	**Simple Linear Regression B Coefficient, [95% CI]** Knowledge Score	**Significance P-value 5% (0.05)**
Gender	-0.900 [-1.718, 0.081]	0.031*
Age	0.041 [-0.006, 0.087]	0.085
18-29 (ref.)		
30-39	1.368 [0.012, 2.723]	0.048*
40-49	1.124 [-1.269, 3.518]	0.356
50+	-0.161 [-2.131, 1.809]	0.872
Marital Status	1.096 [0.043, 2.148]	0.041*
Area of Residency		
Beirut (ref.)		
South	-2.197 [-4.584, 0.190]	0.071
North	1.303 [-0.797, 3.402]	0.223
Mount Lebanon	-0.676 [-1.570,0.218]	0.138
Bekaa	-0.776 [-2.924,1.371]	0.478
Education Level		
High School Diploma (ref.)		
Undergraduate (Bachelor's Degree)	1.376 [0.218, 2.534]	0.020*
Master's degree	1.256 [0.004, 2.509]	0.049*
PhD	-0.162 [-2.472, 2.147]	0.890
Employment Status		
Employed (Full Time) (ref.)		
Employed (Part Time)	0.459 [-0.824, 1.742]	0.482
Actively Seeking	-0.196 [-1.725, 1.334]	0.802
Unemployed / Stay at home parent	0.445 [-1.084,1.975]	0.568
Student	-1.061 [-2.009, -0.112]	0.028 *
Retired	-2.991 [-8.100, 2.119]	0.251
Total Income		
< 1,000,000 LBP (ref.)		
1,000,000-3,000,000 LBP	-0.418 [-1.797, 0.962]	0.552
3,000,000-5,000,000 LBP	-0.302 [-1.756, 1.152]	0.683
> 5,000,000 LBP	-0.584 [-1.905, 0.736]	0.385

Table 6 Multiple Linear Regression

Predictors	Knowledge Score		
	B [95% CI]	**SE B**	**β**
Gender	-0.803 [-1.660, 0.054]	0.436	-0.088
Age			
18-29 (ref.)			
30-39	0.460 [-1.145, 2.065]	0.817	0.030
40-49	-0.157 [-2.901, 2.588]	1.397	-0.006
50+	-0.932 [-3.510, 1.646]	1.312	-0.042
Marital Status	0.855 [-0.720, 2.430]	0.802	0.071
Education Level			
High School Diploma (ref.)			
Undergraduate (Bachelor's Degree)	1.043 [-0.147, 2.234]	0.606	0.116
Master's degree	0.746 [-0.563, 2.054]	0.666	0.076
PhD	-0.533 [-2.878, 1.813]	1.194	-0.022
Employment Status			
Employed (Full Time) (ref.)			
Employed (Part Time)	0.155 [-1.154, 1.464]	0.666	0.011
Actively Seeking	-0.178 [-1.711, 1.355]	0.780	-0.011
Unemployed / Stay at home parent	0.054 [-1.558, 1.667]	0.821	0.003
Student	-1.051 [-2.044, -0.059]	0.505	-0.106 *
Retired	-2.470 [-7.972, 3.031]	2.800	-0.043

CHAPTER IV

DISCUSSION

To the best of our knowledge, this study is the first report that evaluated the knowledge, attitudes and practices of food adulteration in Lebanon. The results showed that there are gaps in the knowledge. Also, significant associations were found between sociodemographic characteristics and knowledge. On top of that, we grasped a good idea on the buying practices as well as their attitudes towards branded and unbranded products and their trust towards them.

37.7% of the participants claimed that they do not read the labels before buying and consuming any product. In a study conducted in 2017 to examine the usage and understanding of food labels in Lebanon, they concluded that the most common reasons for not reading the labels were: 34.9% did not have enough time to, 15.1% believed that there is no need to, 9.8% had no knowledge on how to read them and 8.0% found the labels too small [Hassan, H.F. & Dimassi, H. 2017].

Buying branded products does not necessarily mean that the product will be completely fraud-free, however since most companies go through tests obliged by the government, the risks do decrease. In Lebanon, buying unbranded products from the village is common in almost every household. Only 18.4% claimed that they never buy any unbranded product and the remaining always have at least 1 of the following unbranded products in their kitchen: honey, olive oil, molasses and rice. Unfortunately, Lebanon does not have strict rules obliging all food products that are sold to be tested. Their attitudes towards the Lebanese laws show that there is a lack of trust towards the ability government where only 12 participants (2.4%) were found to believe that the law

is being followed. Nonetheless, their trust for food labels in general is high where 38.9% ‘trust the labels completely and 36.7% only trust labels on imported brands. However, it was shown in several studies that mislabeling is popular all over the world. The Administration Assistance and Cooperation System for Food Fraud (AAC- FF) calculated how many times each method of adulteration was caught in 2019 and concluded that the popular one was mislabeling with 47%. Replacement, dilution, addition, or removal in product was 20%, unapproved processes was 16%, document manipulation, falsification or absence was 15% and IPR infringement was 2% [The EU Food Fraud Network, 2019]. Even though 58% of the participants knew that ‘changing the expiration date’, the lack of knowledge towards adulteration via mislabeling as a whole showed where out of 499 participants ‘claiming milk is lactose free although it is not’ was chosen the least as a method of adulteration: 34.7%.

Comparing this study to a similar study done on residents in Dhaka City, Bangladesh; when asked how food was adulterated, both studies found that the most common response was ‘rotten bread’. As for substances that can be ‘adulterants’, both studies found that the most common response was ‘colorants. However, the Lebanese study showed that the participants had chosen ‘water’ 137 times (27.5%) whereas in Bangladesh it was chosen only once (1%). On the other hand, ‘urea’ was chosen 71 times (14.2%) in Lebanon but 22 times (23%) in Bangladesh [Nasreen, S., & Ahmed, T. 2014]. Even though the percentage in Bangladesh is lower, it is important to note that their sample consisted of 50 participants instead of 499. One common approach for adulterating milk is to mix water in it and then add urea to the resultant milk to raise its ‘solid not fat (SNF) value’ and give it a concentrated and rich appearance [Khan, K.M. et al. 2015]. Even though urea, which is a natural end-product of nitrogen metabolism

and a normal constituent of milk, a limit concentration in milk is normally accepted to be less than 70 mg/dl [Rajendran, R. et al. 2015].

As for total knowledge scores, amongst 499 participants, 73.1% had a low knowledge score and 26.9% had a high knowledge score. It should be noticed that even though 384 people (77.0%) chose that food adulteration can harm our health, 101 of them (20.2%) did not know whether it does or not and 14 claimed that is does not harm us (2.8%). Also, the participants with undergraduate degrees had higher scores than those only with a high school diploma and ones with master's degree had higher scores than both. People aged 30-39 had better knowledge than those aged 18-29. The participants who are students had lower scores than the ones who are employed. The relationship between knowledge score and employment also proved to be statistically significant in the multiple regression proving that students had lower scores than employed participants. This factor is most probably related to the level of education reached. Comparing these results to those of another similar study was done in Karnataka India. They found that amongst 75 participants, only 21% had good knowledge, 60% had average knowledge and the remaining 19% had no knowledge [Abidfaheem, 2013]. Like this study, they also found statistically significant association between knowledge of adulteration and educational level; the higher the education, the more they are aware of adulteration. On top of that, they found a statistically significant association between knowledge of adulteration and age where people ages 25-50 years old had a better knowledge than those over the age of 50 [Abidfaheem, 2013].

One of the main limitations of this study is the fact that it is online; participants are not supervised hence they have the chance to search online and give us the correct answers (information bias). The internet connection can cut or disconnect in the middle

of the survey, causing the dropout rate to increase. Also, the incapability of being social during these times and trying to recruit from all over Lebanon. As we saw in the sociodemographic characteristics, most participants live in Mount Lebanon (selection bias).

CHAPTER V

CONCLUSION AND RECOMMENDATION

"Knowledge and awareness about adulterated foods, laws and its rights related to adulterated food is crucial in a society where technology heightens opportunities for perpetrators of fraud, deception and misrepresentation" (Garman and Jonest, 1992) [12]. Knowledge is crucial for the consumer to protect themselves and their families against these frauds. On top of that, each consumer must know his/her right to safe, non-adulterated food. In Lebanon, we do not have enough tests and preventative measures carried out for the beverages and foods we consume, and we also do not have enough awareness regarding this topic. Food adulteration, or food fraud, is a global problem and spreading awareness is the first step to start decreasing it. The law protecting the Lebanese population is available however not enough testing is happening to imported and local products to find these adulterated foods. The government must conduct routine testing with all food categories and penalize companies who do not conform to the basic food standards. Awareness is key in decreasing this problem as well; by talking about it via social media or on the news would not only give the people the information needed but also alarm food and beverage companies to not disobey the law because now people are aware of what is happening. More future studies must be conducted mainly aiming at finding the prevalence of food adulteration in Lebanon.

APPENDIX I

CONSENT FORM

Dear Participant,

You are invited to participate in a research study entitled "Food adulteration Knowledge, Attitudes and Practices (KAPs) among Lebanese adults: a cross-sectional study."
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 on food adulteration.
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 720 participants who are at least 18 years old, who participate in shopping for the needs of their home, and are currently residing in Lebanon
- Participants will be recruited via invitations posted on social media
- Completing the online 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

You will not receive any payment for participation in this study. Also, there will be no direct benefits to you.

However, the studying the knowledge, attitudes and practices of the Lebanese population will provide us with valuable insight on how well informed this population is.

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 or withdrawal from 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

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 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

ONLINE SURVEY

A) Socio - demographic

1. Gender
   a. Male
   b. Female

2. What is your age? _____

3. Marital Status
   a. Single
   b. Married
   c. Divorced
   d. Widowed

4. Area of Residency
   a. Beirut
   b. South
   c. North
   d. Mount Lebanon
   e. Bekaa

5. Highest level of education achieved
   a. High School Diploma
   b. Undergraduate degree (bachelor's degree)
   c. master's degree
   d. PhD

6. What is your current employment status?
   a. Employed full- time
   b. Employed part-time
   c. Seeking employment
   d. Unemployed/ Stay-at- home parent
   e. Student
   f. Retired

7. What is the total monthly income of your household?
   a. < 1,000,000 LL
   b. 1,000,000 – 3,000,000 LL
   c. 3,000,000 – 5,000,000 LL
   d. > 5,000,000 LL

B) Buying Practices

1. Who buys the grocery?
    - Myself
    - Parents
    - Spouse
2. Do you read food labels before buying/ consuming any product? (Yes /No)

3. If yes, what do you focus on?
    - Ingredients
    - Nutrition Fact Sheet
    - Just Calories
    - Storage instructions
    - The addition of food additives
    - Nutrition claims (gluten free, lactose free, high in fiber…)
    - Health claims (heart healthy, calcium for healthy bones …)

4. What do you most look out for while buying/ consuming any product?
    - Expiry Date
    - Price
    - Brand
    - Local products
    - Imported products
    - Appearance of packaging

5. In your household, do you buy/ consume mainly branded or unbranded foods? Ex: Mazola olive oil (branded) or not? (Branded /Unbranded)

6. If you buy/ consume unbranded, what are the products?
    - Honey
    - Olive oil
    - Rice
    - Molasses
    - Other, please specify…

7. Do you <u>trust</u> the labels (ingredients, expiration dates, nutrition label etc…) placed on the packages?
    - Yes, I trust them completely
    - I only trust labels on imported brands
    - I only trust labels on local brands
    - I do not trust the labels

C) Knowledge on Adulteration

1. How is food adulterated?
    - Rotten bread
    - Water added to a milk bottle
    - Chalk added to turmeric powder
    - Coloring dyes added to tea
    - Changing the expiry date
    - Claiming milk is 'lactose free' although it is not

2. Do you believe that adulterating food may affect your health? (Yes or No)

3. Which substance(s) do you believe can be considered adulterants?

- Urea
- Coloring
- Pebbles
- Chalk
- Sand
- Water

5. Have you ever experienced food adulteration from bought goods? (Yes/No)

5. If yes, what was your reaction? Tick ✓or *X* next to the following option(s)

- Directly threw away the food
- Call the company on their Customer Hotline and informed them
- Call the supermarket from where I bought the food and informed them
- Stopped purchasing this brand
- Gave the brand another chance
- Nothing

6. Which foods do you believe can be adulterated? Tick ✓or *X* next to the following option(s)

- Fruits & Vegetables
- Flour, wheat and bakery products
- Meats and meat products
- Juices
- Honey
- Milk
- Spices
- Salt
- Sugar
- Rice

- All the above

6. Do you believe that Lebanon has a law against adulteration? (Yes / No)

7. If yes, do you believe it is being followed? (Yes / No)

9. What do you believe is true (choose 1); the level of food adulteration in Lebanon is:
   - Low, hardly happens
   - Moderate, can happen with foods of low cost
   - High

APPENDIX III

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)

It is not an Official Message from AUB

I am inviting you to participate in a research study about "Food adulteration Knowledge, Attitudes and Practices (KAPs) among Lebanese adults: a cross-sectional study."

The purpose of this study is to investigate the knowledge, attitudes and practices of the Lebanese population towards food adulteration as well as identify factors, demographic characteristics for example, associated with food adulteration, and to identify areas of improvement, raise awareness and provide recommendations that could be beneficial for policy decision-makers

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

You are invited because we are targeting people who are at least 18 years old and are currently residing in Lebanon

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

The research is conducted online and is hosted on AUB server

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 (May Khanafer, 71576740, mmk71@mail.aub.edu)

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