

INTAKE ASSESSMENT OF THYME AND THYME PRODUCTS IN
LEBANON USING A FOOD FREQUENCY QUESTIONNAIRE

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Master of Science in Food safety and Quality Management

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Abstract:

Thyme intake assessment is gaining significance because thyme is becoming a global staple food and its use has been on the rise. Limited research has been done on the assessment of dietary patterns on thyme and thyme products in Lebanon. The aim of this study was conducted. For this purpose, a developed FFQ was carried on a convenient sample of 1555 adult participants. Out of the total, 1523 persons (97.9%) consumed at least one thyme product. The mean consumption of thyme products was estimated to be 425.5 g/day, providing an estimated 31.4 g/day of thyme. Thyme pie had the highest mean intake (72.5 g/day) and represented the highest thyme contribution (10.4g/day) among all thyme products while crackers with thyme had the lowest mean intake (3.7 g/day) and the lowest thyme contribution (0.2 g/day).. The mean consumption values for thyme products were significantly different between participants of different genders, age categories, socio-economic and demographic levels ($p < 0.05$). This study highlighted the importance of a food frequency questionnaire as a tool for data collection about the consumption patterns taking into account the consumed portion size of a specific thyme product as well as the frequency of consumption, without neglecting the added quantity of thyme. has to be more directed, leave a message when you finish reading

Keywords: Thyme, food frequency questionnaire, dietary intake, portion size.

Chapter I:

1. Benefits of Herbs:

Thyme is the most popular herb worldwide. It is a part of several recipes in different cuisines including European, Mediterranean, American and many more. It could be used in two forms, either fresh or dried. (Kapadia,J., 2020). This herb is mostly found on the lands of the Western Lebanon Mountain of altitudes between 200 and 1500 m (Hamade, 2016). Moreover, herbs and spices are considered components of daily usage and act as primary agents for flavoring in many sectors such as foods, pharmaceuticals; in addition, they are used in the production of perfumes and cosmetics (Peter, 2012).

It has been shown that herbs and spices had several health benefits including anti-diabetic, anti- carcinogenic, anti- inflammatory, anti-bactericidal due to its two bioactive compounds named thymol and carvacrol which acts as anti-fungal, anti- obesity, anti-hypertensive, anti-oxidant and many more (Isbill et al. 2018&Jeambey et al.2009).

In addition, short term trials showed that herbs had an acute health improvement effect such as lowering the oxidative damage in plasma, as well as lowering the percentage of early neoplasms (Blanton, 2020).

As for the thyme leaves, they contain essential oils that are used for different purposes where it could be introduced in food due to its aroma, flavor and preservation properties (Shelbaya, 2016). Furthermore, thyme can relieve cough and regulate gastrointestinal disturbances (Jeambey et al. 2009).

2. Regulations concerning collection of Thyme:

In 2012, the Lebanese Ministry of Agriculture (MOA) has set several regulations in order to organize the collection and exportation of thyme products:

- Required having a legal permission for collection and exportation
- Defined the collection of thyme only between June and October
- Specified the collection to 2/3 of branches and plants population
- Required to not remove plants from their roots
- Stand in need to have permission from responsible municipality before collecting from public lands

However, these regulations were not effectively applicable yet by MAO and citizens (Hamade, 2016).

3. Consumption of herbs and spices in different countries:

Herbs and spices are becoming a worldwide trend and their use is on increasing demand in the last century (Szucs et al. 2017). In Lebanon, thyme is the most culinary herb that is cultivated and consumed. However, Lebanese thyme exportation is gaining significant importance in EU and North American Countries (Hamade, 2016) (Fig.2). Asian (India, Thailand and china), Latin American countries and South Africa are considered to have the highest consumption of herbs and spices. Adding to this, the highest consumption of thyme in EU countries was shown in Austrian respondents while, the highest consumption of oregano was observed in Irish respondents (Szucs et al., 2017) (Fig.1). However, herbs and spices are gaining importance in EU and North America due to their popularity as “zero calories superfood” (Gajewska et al. 2020).

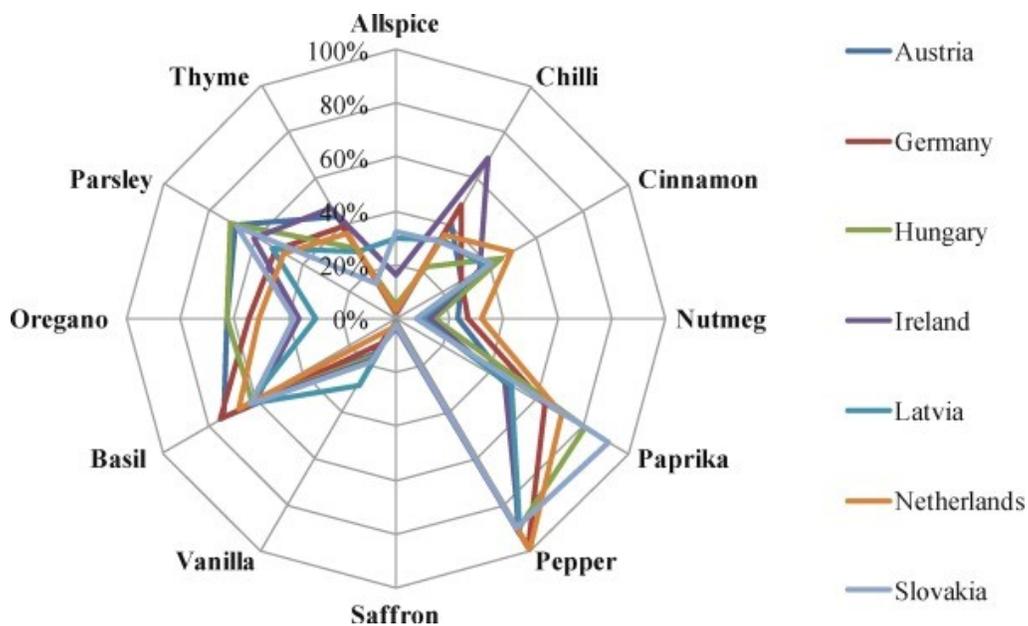


Figure 1: Most frequently consumed herbs and spices in the analyzed countries.
source: Szucs et al. 2017

Figure 13. Distribution of Lebanon export of zaatar mixes and *O. syriacum* 2015

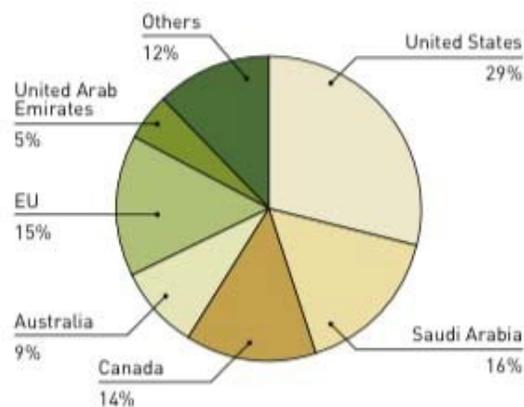


Figure 14. Distribution of Lebanon export of zaatar mixes and *O. syriacum* 2012

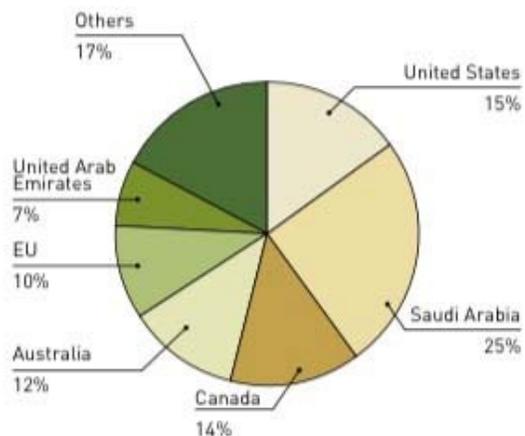


Figure 2: Distribution of Lebanon export of zaatar mixes and *O. syriacum* in 2012 and 2015

Source: FAO, 2018

4. Methods for assessing dietary intake:

Dietary consumption of certain nutrients and components are of major concern when considering non-communicable diseases (NCDs) worldwide. (Nasreddine et al. 2006). Some unwanted components are naturally occurring in food, or are formed accidentally due to handling or processing. Thus, collecting data about types and amount of food consumed at an individual level can be used as a mean to assess the level of consumption. (Nasreddine et al., 2006).

Therefore, measurement of thyme intake is of considerable importance because of the knowledge of their beneficial health impact as well as for estimating contaminant intakes that are responsible for major health risks. It is very important to assess the risk benefit ratio of thyme which could be accomplished through collection of data about the portion size consumed of a specific food item containing thyme as well as the frequency of consumption, without neglecting the added quantity of thyme (Siruguri & Bhat, 2015).

This method of quantification present a wide range of challenges since thyme is considered difficult to quantify in served food portions. Accurate measurements are crucial to be used for the assessment of food and nutrient intake to prevent measurement errors leading to false diet and disease associations (Saravia et al., 2018).

The assessment of dietary intake habits is complicated due to several factors including the availability and variability in food preferences, socio-economic factors, geographical, psychological and educational level factors that are iteratively involved in food decision making. For that reason, choosing an appropriate method for assessing dietary intake is considered a decisive step in order to minimize biases and reporting problems (Saravia et al., 2018).

Many techniques are found when assessing the dietary intake. They differ based on their level of complexity and can be sorted as simple techniques or more complex techniques. The simple techniques include 24h recalls, food records, diet histories and Food Frequency Questionnaire (FFQ), while the complex techniques are biochemical tests considering nutrient intakes in blood and urine (Moghames,P, 2015). Diet histories are used for collecting information about usual nutrient intake for long period. Also, this method is habitually used in clinical practices rather than in research studies (Morán et al., 2015). As for the diet records, it is a method that allow to assess the total dietary intake over a specific period of days, while 24 hour recall is limited to the total dietary intake in 24 hours (FAO,2018). Thus, FFQ is a method to assess dietary intake over a long period of time within a defined population. This population could be adults, children and adolescent (Saravia, L., et.al,2018). Also, FFQ tend to be less time consuming, inexpensive, than 24h recall and food records (Moghames et.al, 2015). In addition, by using FFQ, a single administration is capable of capturing the variability and availability of food (Zalaket et al., 2019).

Previously discussed methods examine the relationship between diet and disease, but food frequency questionnaires can also identify the dose response relationship. In addition, these methods are susceptible to memory and recall biases (FAO,2018).

5. Food Frequency Questionnaire:

The FFQ method is proven to be a simple and effective tool to gather data about food consumption patterns on individual basis (Giovannelli et al., 2014). Also, it identifies the association between consumption of a particular food containing specific hazards over a specified period of time (Zalaket, 2019).

Food frequency questionnaires have several types including: qualitative, semi-quantitative and quantitative. Qualitative FFQ do not ask about the portion size consumed, whereas, the semi-quantitative FFQ, include standard portion sizes, and the quantitative FFQ, ask respondents to estimate the portion size consumed either in household measures or grams (Ortega et al., 2015)

The total food intake cannot be calculated using classic FFQ, since it includes only information about frequency of consumption of food items, but, a quantitative FFQ includes in addition to the frequency, information about serving sizes and usual portion size using realistic food models or by the aid of pictures (Nasreddine et al., 2006).

The results of a study done in Burkina Faso, have shown that photographs are important tools for the quantification of portion size in less educated women mainly in rural areas (Jayawardena et al., 2012).

Also, a great attention should be given on the development of FFQ and the information that should be included. It is important to identify the number of food items, having accurate questions to minimize bias and to identify portion sizes (Carslen et al., 2010).

6. Findings of studies using FFQ:

A food frequency questionnaire was done by Nasreddine et al. (2006) on 444 adults (25-40years) through stratifying Beirut into nine subunits, in order to assess the food consumption patterns of Lebanese Population. The FFQ collects personal data information, indicators of socio-economic level, weight (kg), height (cm) and the use of supplements. Results showed that fat highly contributed to the daily energy intake by

38.9%, whereas 76.3% and 45.3% of subjects consumed fish and fruits/vegetables respectively lower than the recommended daily intake (Nasreddine et al. 2006).

Similarly, another semi quantitative food frequency questionnaire was used to identify and evaluate the dietary patterns of 525 older adults (>50years) in Lebanon, based on stratified-cluster sampling. The strata were the Lebanese Governorates and the clusters were selected further at the level of districts covering urban and rural areas. This FFQ included socio-demographic and lifestyle questions, as well as, anthropometric measurements. The Results showed that 3 dietary patterns were identified: a Western, a Lebanese, and a High Protein/Alcohol pattern. It showed also that the Lebanese pattern was associated with better health quality and high intake of fiber (0.57g), folate (0.49g) and vitamin C (0.54 mg) (Jomaa et al., 2016).

Furthermore, a spice intake questionnaire was developed on 100 households in order to collect information on spice consumption of 17 spices routinely used in Indian cuisine based on pattern of spice used and portion size of spice consumed. The results showed that FFQ have an important utility for risk assessment of chemicals or food contaminants such as aflatoxins that may be consumed through spices. The findings of this study have also showed that turmeric and red chilies are consumed by 100% of the population. The highest mean intake was observed for chillies of 0.3g per portion size, while, the lowest value was obtained for nutmeg and mace with a mean of 0.4 and 0.21g, respectively (Siruguri & Bhat, 2015).

In addition, a food frequency questionnaire was developed for assessing the dietary intake of 482 Sri Lankan adults. This study is based on a random-stratified sampling procedure and the FFQ revealed information about socio-economic factors. The results

indicated that the main source of energy was consumed from carbohydrates for both male and female. The mean intake of carbohydrates for men is 352.4 g/day which is higher than 277.5 g/day for female (Jayawardena et al., 2012).

A food frequency questionnaire was developed for assessing habitual dietary intake of salicylates from herbs and spices among Polish omnivores and vegans. The study population consisted of 270 adults aged between 19 and 67 years old. The results showed that parsley, garlic, dill, marjoram and basil were the most frequently consumed among omnivores whereas, garlic, parsley, ginger, basil and ill were the most consumed among vegans (Gajewska et al., 2020).

A self-administered questionnaire conducted in the seven member states of the EU and aimed to assess the herb and spice consumption habits. The study participants were 1731 European adults who prepare their food at home. This study showed that pepper, paprika, parsley; basil was the most frequently consumed spices and herbs (Szucs et al. 2018).

A semi-quantitative questionnaire was developed by Dehghan et al. 2005 to assess the dietary intake of Arab population aged more than 18 years old in United Arab Emirates (UAE) and Kuwait. Results showed that participants in UAE consumed more fruits (3.4 servings/day) than those in Kuwait (2.8 servings/day). In contrast, participants in Kuwait consumed more vegetables (3.1 servings/day), cereals (5.3 servings/day), dairy products (3.4 servings/day) than the participants living in UAE with frequencies of 2.8, 4.8, 2.2 servings per/day, respectively (Dehghan et al., 2005).

7. Objectives, research question and hypothesis of the study

Our knowledge of the consumption pattern of thyme in Lebanon is based on very limited data. Thus, the aims of this study were to assess the average daily consumption in the

Lebanese population, identify the most consumed thyme products and compare their consumption between populations of different socio-demographic and economic factors by mean of a food frequency questionnaire.

Our research Questions: “What is the average daily consumption of thyme products in the Lebanese population? Is this consumption affected by socio-demographic and economic factors? What are the most consumed thyme products?”

Our hypothesis is: “The Lebanese population regularly consume most of thyme products in their diet especially the thyme pie and thyme sandwiches. In addition, the socio-demographic and the economic status have significant effect on thyme products intake.”

Chapter II:

1. Introduction:

Herbs and spices are widely used ingredients in food preparation. They are becoming a global trend and their use has been on the rise in the last century (Szucs et al. 2017).

Export of Lebanese Thyme gained significant importance and reached 15% in Europe and 29% in American Countries. (Hamade, 2016).

Thyme is the most frequently used herb and it is a part of several recipes in different cuisines including European, Mediterranean, American and others (Kapadia, 2020). It could be used in two forms, either fresh or dried (Kapadia, 2020). Furthermore, it could be associated with other ingredients in order to develop a very commonly used mixture consisting of dried thyme, sesame seeds, sumac, and olive oil (Culture of Arab Food, 2017). This mixture can be used in several recipes such as pita bread sandwiches, pizza topping, pies (known as manakeesh) crunchy bread sticks (known as Kaak), dressings, soups.

Thyme has many beneficial effects on human health. It can be considered as a table salt substitute, and thus decrease the risk of cardiovascular diseases and help hypertension patients to limit their salt consumption and therefore maintain their blood pressure level and therefore (Gajewska et al., 2020).

Thyme has a high vitamin content, such as vitamin E (antioxidant), folate, riboflavin, biotin, as well as other minerals like iron, potassium, calcium and zinc. It also contains several active chemical compounds, such as carvacrol that, in addition to its antimicrobial properties, was found to help in preventing obesity and diabetes in mouse models (Dauqan & Abdullah, 2017).

However, thyme and its mixing ingredients can be exposed to biological and chemical contaminants, causing a threat to human health. These contaminants may be introduced to food through multiple pathways; such as environmental pollution (inorganic contaminants such as heavy metals) and poor agricultural practices (pesticide residues and mycotoxins) (Arnich et al., 2012).

Therefore, assessment of thyme products consumption is of considerable importance to assess both the health benefits and risks of exposure to contaminants through their dietary intake. This can be accomplished by the mean of data collection at the individual level targeting the portion size consumed of a specific food item containing thyme as well as the consumption frequency, without neglecting the added quantity of thyme (Siruguri & Bhat, 2015).

Simple and complex techniques were used to assess the dietary intake. The simple techniques include food records, 24 hour recall, diet histories and FFQ, while the complex techniques are biochemical tests considering nutrient intakes in blood and urine (Moghames et al., 2016). FFQ is a method used for epidemiological studies in order to assess long-term food consumption pattern of a particular item within a defined population.

A single administration is capable of capturing the variability and availability of food when using FFQ (Saravia et al., 2018). Moreover, FFQ can rank individuals according to their usual intake (Saravia et al., 2018).

FFQ, 24 hour recall, diet records and diet histories examine the relationship between diet and disease, but FFQ can additionally identify the dose response relationship. However,

all previously discussed methods are susceptible to biases such as memory and recall biases (FAO, 2018, Morán Fagúndez, 2015).

Methods of quantification present a wide range of challenges; thus, accurate measurements and knowledge of frequency of consumption are crucial to assess food intake in order to prevent measurement errors leading to false diet and disease associations (Saravia et al., 2018). Previous studies used food frequency questionnaire to assess various dietary intakes including herbs and spices. These were conducted in Asian countries such as Southern India (Siruguri & Bhat, 2015), Sri Lanka (Jayawardena, 2012), Japan (Sunami, 2016), Middle East countries such as Jordan (Tayyem, 2020) and European countries including Austria, Germany, Hungary, Ireland, Latvia, Slovakia, the Netherlands (Szucs, 2016), Norway (Carlsen, 2010), France (Gazan, 2017), Belgium (Tollosa et al. 2017).

In Lebanon, several studies used FFQ for assessing food consumption patterns of different food groups for adults in Beirut (Nasreddine, 2005), for estimating vitamin intake A,C,E in rural and urban areas all over the country (Zalaket, 2018) and for evaluating adults eating habits among Lebanese University students in Beirut (Yahia, 2008). However, no studies in Lebanon have been done so far to estimate thyme consumption, especially, that this product is becoming trendy and staple worldwide.

Therefore, the key objectives of this study were to (i) assess the frequency and average of thyme products consumption in Lebanon, (ii) identify the most consumed thyme products, (iii) assess the effect of socio-demographic and economic factors on thyme consumption.

2. Materials and Methods:

2.1- Study population: Sample Characteristics

A cross-sectional survey was carried out on a convenient sample of adults living in Lebanon. The sample size calculation was performed using Epi InfoTM based on a 50% prevalence of thyme consumption and a precision (d) of 2.5% yielding a target number of sample size equal to 1541 participantstaking into consideration that the total Lebanese population was equal to 3.8 million (CAS, 2012).This number was proportionally distributed and stratified into the 5 administrative regions (CAS, 2012): Beirut, Mount Lebanon and Beirut suburbs, North, South and Bekaa (Table 1). We have exceeded this target number by additional 16 questionnaires to have a total of 1555 participants. If the participant had children (aged below 18 years old), additional consumption data was filled by any of the parents on their behalf.

Table 1: Distribution of sample habitants in different administrative regions (CAS¹,2012).

Administrative Regions	Percentage of habitants (%)	Number of sample population (habitants)
Beirut	9	139
Mount Lebanon + Beirut suburbs	41	632
North	20	308
Bekaa	12	185
South	18	277
Total	100	1541

¹CAS: Central Administration of Statistics

2.2- Food consumption and dietary assessment method

Food consumption data were obtained using a semi-quantitative Food Frequency Questionnaire (FFQ) to estimate food intake between April 2018 and January 2019. This questionnaire consisted of closed-ended questions divided in three parts:

The first part addressed questions related to personal data, weight (kg) and indicators of socio-economic level, such as area of residence, educational and income levels.

The second part was a table that consisted of a list of 14 thyme-containing products that are commonly used by Lebanese population. These items were selected through market screening. The English, traditional names, thyme content/contribution and photos of the thyme products are shown in Table 2. The thyme content of each product was estimated through reference recipe formulations from cookbooks (REF) or by weighing the added thyme using a digital high precision (± 0.01 g) balance (Gerbertini Europe 500 machine, Italy).

The questionnaire was piloted with 50 participants before the beginning of data collection. The study participants were interviewed face to face by a trained dietitian for around 7 to 12 minutes. If the participant had children (aged below 18 years old), an additional consumption data was filled by any of the parents on their behalf.

The participants were asked to estimate the frequency of consumption ranging from daily, weekly, monthly, less than 1 month and never eaten as well as the standard portion size consumed. Furthermore, any exceptional or increased consumption and sources of products were also considered. The participants who never consumed a thyme product

were considered as non-consumers. Each food item in the FFQ was assigned a portion size using photographs and standard local household units such as plate, bowl, spoons of different size (tablespoon, teaspoon) and tea cups.

The third part provided tool for helping participants to accurately report the quantity and source of thyme products intake by suggesting standard reference portion pictures, brands and bakeries for thyme products.

Table 2: Thyme products assessed in the Food Frequency Questionnaire

English name	Traditional name	Abbreviations	Thyme contribution % (w/w)	Photo
Thyme pie	Manoushe zaatar	TP	14.3 (10.4)	
Cheese and thyme pie	Manooshe cheese and zaatar	CTP	5.6 (3.1)	
Fresh thyme salad	Fresh zaatar salad	FTS	3.5 (2.4)	 
Thyme regular mix sandwich	Zaatar regular sandwich	TRS	31.0 (5.2)	
Thyme mix with nuts and seeds sandwich	Zaatar mix with nuts, seeds...sandwich	TNS	34.5 (3.9)	

Pizza and pasta with thyme sauces	Pizza and pasta with zaatar sauces	PP	1.2 (0.3)	 
Bread sticks with thyme (crunchy)	Kaak with zaatar (crunchy)	BS	11.6 (0.6)	
Sesame thick bread with thyme (soft)	Kaak with zaatar (soft)	SB	6.8 (0.9)	
Crackers with thyme	Crackers with zaatar	CT	6.7 (0.2)	
Toast/Bread with thyme	Toast/bread with zaatar	TB	3.4 (0.2)	
Thyme croissant	Croissant zaatar	TC	9.4 (0.9)	
Traditional molded aged cheese with thyme Traditional strained yogurt balls with thyme	Chanklish Labneh mkaazaleh	TCY	1.1 (0.2)	 
Homemade or catering recipes with thyme	Homemade or catering recipes with zaatar	HMC	7.7 (4.8)	 

Tea thyme	Zaatar tea	TT	1.7 (0.9)	
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Thyme products intake was expressed as daily consumption in grams (g/day) taking into account the “frequency of consumption” and the estimated “portion sizes”.

This study was approved by the Institutional Ethical Review Board at Notre Dame University and a consent form was signed by each participant before filling the FFQ.

2.3- Statistical Analysis:

Statistical analyses were performed using the Statistical Package for Social Sciences (IBM SPSS statistics version 20) software. The analyses were stratified by age and gender whenever appropriate. T-test was performed in order to compare mean consumption values between genders (men and women), and ANOVA to compare demographic, socioeconomic characteristics, and age groups.

The results were expressed as means \pm SD (standard deviation) and frequency (%).

Differences were considered statistically significant at $p < 0.05$.

3. Results and Discussion:

3.1- Socio-demographic characteristics

Among the total number of interviewed participants (n=1555, 1523 adults (97.9%) were consumers of thyme products (Table 3). All participants and consumers had almost similar values for socio-demographic characteristics with an average age of 35 years old

and weight of 72 Kg. Females were the biggest proportion of the Lebanese population (Nasreddine et al., 2006, CAS,2010, est), as similarly reflected in our study where 56.8% of the participants were females.

Participants were recruited according to the percentage of habitants in the 5 main residence areas in Lebanon and the majority of the participants were located in urban (64.7%) areas (Tables 1,3). Most of the participants had a bachelor degree (45.9%), followed by technical/high school (24.6%) then elementary (13.8%) and postgraduate (15.7%). As for the income, more than 75% of the participants earned more than 1000\$ per month (1\$ was equivalent to 1515 LBP).

Table 3 Socio-demographic characteristics of total participants of thyme products

Variable	Total participants	Consumers
	Mean ¹ (SD ²)	
Age	35.3 (15.6)	35.4 (15.7)
Weight	72.3 (15.3)	72.4 (15.3)
	Frequency (%)	
Number of participants	1555 (100)	1523 (97.9)
Gender		
Male	672 (43.2)	661 (43.4)
Female	883 (56.8)	862 (56.6)
Area of residence		
Mount Lebanon	634 (40.8)	628 (41.3)
	317 (20.4)	296 (19.4)
North	139 (8.9)	137 (9.0)
	277 (17.8)	274 (18.0)
Beirut	188 (12.1)	188 (12.3)
South		
Bekaa		
Urban	1004 (64.7)	993 (65.2)
Rural	551 (35.3)	530 (34.8)
Education level		
Elementary school	215 (13.8)	214 (14.0)
Technical/high school	381 (24.6)	376 (24.7)
Bachelor	716 (45.9)	696 (45.7)

Master/Doctorate/Post doctorate	243 (15.7)	237 (15.6)
Household income (US \$³per month)		
≤499	77 (5.0)	77 (5.1)
500-999	263 (16.9)	259 (17.0)
1000-1999	426 (27.4)	422 (27.7)
2000-2999	376 (24.2)	361 (23.7)
≥3000	413 (26.5)	404 (26.5)

¹Mean consumption values are expressed in years old for age and kg for weight.

²SD: Standard Deviation

³Each 1 US\$ is equivalent to 1515 Lebanese Pounds (LBP)

3.2- Frequency of consumption

Thyme regular mix sandwich, thyme pie and fresh thyme salad were observed to have the highest frequency of consumption among thyme products on daily (9.1, 3.3, 5.2%, respectively) and weekly (25.3, 34.9, 19.7%, respectively) basis (Table 4). Also, on a monthly basis, thyme pie was the highest consumed thyme product (36.1%), followed by pizza and pasta with thyme sauces (33.8%) and thyme croissant (26.4%). However, the lowest frequency of less than once per month and never, was observed for sesame thick bread (14.9%) and tea thyme (82.2%),, respectively (Table 4). In a study done in North-East Lebanon by Jeambey et al. in 2009, thyme herbs were among the most consumed herbs with a frequency of 5 times per week (Jeambey et al.,2009)

In United Arab Emirates and Kuwait, a culture-specific FFQ showed that cereals were an important food category with a frequency of consumption of 4.8 times and 5.3 times per day, respectively. Our study findings list several cereal group products such as thyme pie, cheese and thyme pie, crackers, pizza and pasta, as being the most frequently consumed, making them an important category in Lebanese and Arab populations' diet.

On the international level, fresh thyme salads are typically used in world-wide cuisines due to their popularity. Oregano was the most consumed herb in Austrian population with a frequency of 63%, while the most consumed herbs in Irish population were chilli, thyme and saffron with frequencies of 69.2, 47.8, 3.0% , respectively (Szűcs et al., 2018).

Table 4 Frequency of thyme products consumption by the participants

Frequency of Consumption % (n)					
Thyme product	Never	<1/month	Monthly	Weekly	Daily
TP	14.7 (229)	11.0 (171)	36.1 (562)	34.9 (541)	3.3 (52)
CTP	52.7 (821)	11.3 (176)	22.8 (354)	12.6 (195)	0.6 (9)
FTS	42.4 (659)	8.6 (133)	24.1 (376)	19.7 (306)	5.2 (81)
TRS	33.8 (525)	8.0 (124)	23.8 (371)	25.3 (393)	9.1 (142)
TNS	69.5 (1081)	6.0 (94)	13.2 (206)	9.2 (143)	2.1 (31)
PP	46.9 (730)	8.0 (124)	33.8 (527)	10.8 (167)	0.5 (7)
BS	58.5 (910)	10.2 (159)	19.2 (299)	9.0 (139)	3.1 (48)
SB	52.4 (815)	14.9 (231)	25.9 (403)	6.5 (101)	0.3 (5)
CT	69.0 (1074)	8.0 (125)	13.7 (212)	8.2 (127)	1.1 (17)
TB	76.8 (1196)	6.3 (98)	11.1 (173)	4.4 (66)	1.4 (22)
TC	51.0 (794)	14.6(228)	26.4 (409)	7.7 (120)	0.3 (4)
TCY	55.2 (858)	9.1 (142)	21.5 (333)	12.7 (199)	1.5 (23)
HMC	69.8 (1087)	7.3 (114)	13.1 (203)	8.3 (129)	1.5 (22)
TT	82.2 (1278)	5.6 (87)	5.3 (83)	4.7 (73)	2.2 (34)

TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

3.3- Quantity of thyme products intake

Percentage of consumers, mean consumption values, and thyme contribution for each of the 14 thyme products during routine and increased consumption are shown in Table 5.

The majority of the participants (85.3%) consumed thyme pie, followed by thyme regular mix sandwich (66.2%), while tea thyme had the lowest percentage of consumption (17.9%). Thyme pie had the highest mean intake (72.5 g/day) and represented the highest thyme contribution (10.4 g/day) among all thyme products while crackers with thyme had the lowest mean intake (3.7 g/day) and the lowest thyme contribution (0.2 g/day) (Table 5).

Thyme pie is a traditional Lebanese product that many people would have for breakfast. It is also a perfect appetizer when served in small sized dough. The high consumption observed can be related to its affordable price and availability on the go in all Lebanese bakeries. On another note, tea thyme was the least consumed due to the popularity of other types of herbal teas such as green tea and black tea.

Table 5 Percentage of consumers, mean consumption values (g/day) and thyme contribution (g/day) for each thyme product during routine and increased consumption

Routine consumption

Increased consumption

Thyme products	Consumers % (n)	Mean ¹ ±SD ²	Thyme contribution	Consumers % (n)	Mean±SD	Thyme contribution	p value
TP	85.3 (1323)	72.5±109.4	10.4	10.1 (154)	141.9±119.8	20.3	<0.001*
CTP	47.2 (733)	55.2±85.4	3.1	3.2 (48)	167.3±198.5	9.4	<0.001*
FTS	57.6 (892)	68.2±115.4	2.4	11.2 (171)	115.8±101.2	4.1	<0.001*
TRS	66.2 (1027)	16.8±24.2	5.2	6.2 (95)	34.0±29.7	10.5	<0.001*
TNS	30.5 (472)	11.2±18.2	3.9	2.7 (41)	29.2±20.4	10.1	<0.001*
PP	53.1 (821)	27.3±37.4	0.3	3.8 (58)	28.8±160.1	0.3	0.275
BS	41.5 (641)	5.0±11.1	0.6	3.7 (57)	13.4±14.2	1.5	<0.001*
SB	47.6 (737)	13.9±28.5	0.9	2.9 (44)	40.8±80.7	2.7	<0.001*
CT	30.9 (477)	3.7±6.0	0.2	3.2 (48)	7.7±9.5	0.5	<0.001*
TB	23.1 (357)	6.6±15.2	0.2	1.2 (18)	9.8±7.0	0.3	<0.001*
TC	49.0 (760)	9.6±19.0	0.9	1.8 (28)	23.0±27.7	2.2	<0.001*
TCY	44.8 (693)	20.9±47.8	0.2	3.0 (45)	38.8±39.5	0.4	<0.001*
HMC	30.1 (463)	61.9±123.3	4.8	1.6 (25)	122.2±102.6	9.4	<0.001*
TT	17.9 (265)	52.7±78.7	0.9	4.7 (72)	119.0±78.9	2.0	0.001*

* $p < 0.05$ is considered significantly different for routine and increased consumption

¹ Mean consumption and thyme contribution values are expressed in grams per day

²SD: standard deviation

TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

Several factors changed and increased significantly the mean consumptions of all thyme products except pizza and pasta with thyme sauces (Table 5). Such factors were cultivation season (12.3%), lent meals (10.5%), school snacks (3.6%), picnic meals (1.2%), weight loss diet (5.1%) and sickness remedies (2.0%). This is in line with study findings in North-East Lebanon, where thyme herbs were among the mostly consumed in the winter season as compared to other seasons (Jeambey et al., 2009). Sickness factor can also increase the consumption of herbal teas for medicinal purposes for example flu and intestinal discomfort (Söukand et al., 2013).

3.4. Number of thyme products consumed

Eight point seven % to 13.6% of the participants consumed 3 to 7 thyme products, followed by 7.0 to 9.6% who consumed 8 to 9 thyme products. While the consumption percentage of 0 to 3 thyme products was almost similar to that of 10 to 14 thyme items which ranged between 0.5 to 5.3% (Fig.1). Lebanese population consumed thyme products in its different forms since thyme can be used in different ways and forms. A study done by Jeambey et al. (2009), reported that participants had an increased consumption of several herbs, including thyme, since it could be used either fresh such as in salads, or when it is ground and mixed with sesame seeds, sumac, salt and olive oil (Jeambey et al.,2009).

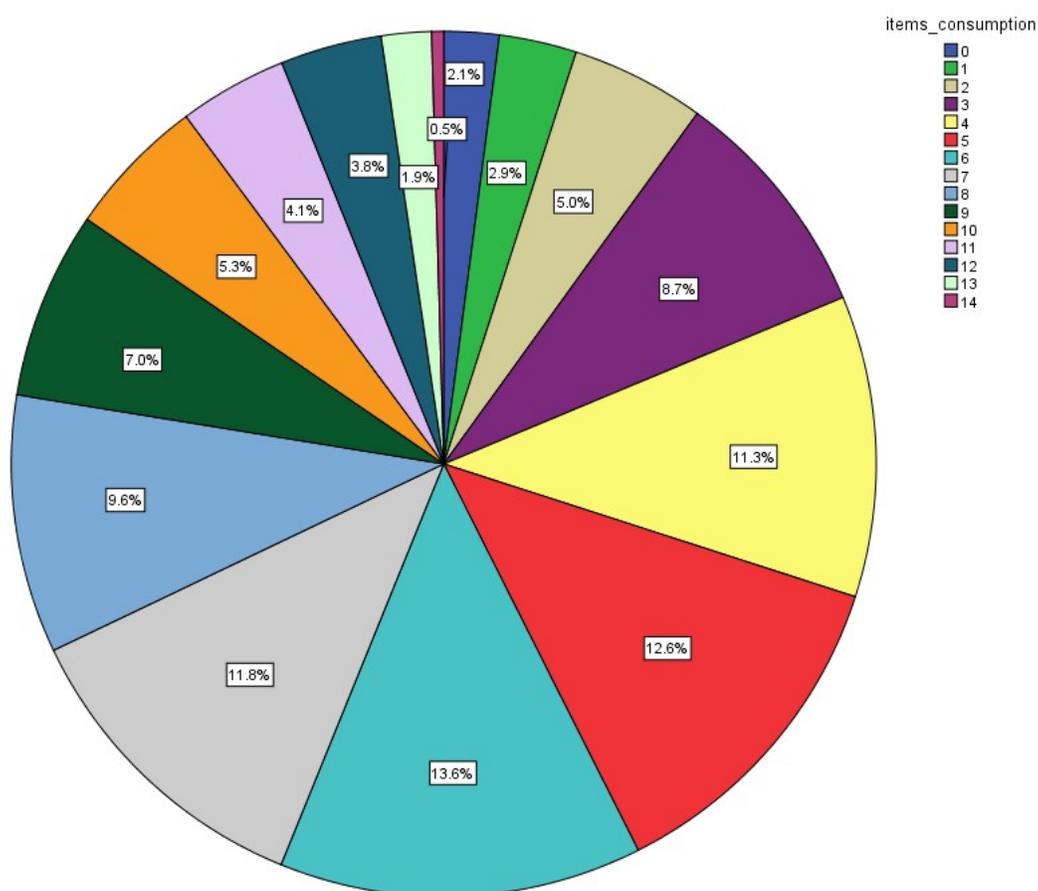


Figure 3: Number of thyme products consumed by the participants (n=1555)**3.4. Age and Gender**

Mean consumption values by age and gender are shown in table 6. Consumption of thyme pie, fresh thyme salad, thyme regular mix sandwich, crackers with thyme and traditional molded aged cheese with thyme/ traditional strained yogurt balls with thyme (TCY) significantly differed between age groups ($p < 0.05$); with the highest consumption among participants aged more than 60 years old for fresh thyme salad (106.6 g/day), thyme regular mix sandwich (21.7 g/day), and TCY (27.0 g/day). The lowest consumption was for those aged between 18-24 years old for fresh thyme salad (47.7 g/day) and thyme regular mix sandwich (12.7 g/day), whereas, group aged between 35 and 44 years represented the lowest consumption for TCY (14.5 g/day) (Table 6). Opposite trend was observed for crackers with thyme where the highest consumption was among the participants aged 18-24 years (4.4 g/day) and the lowest consumption among participants aged more than 60 years (2.5 g/day). On the other hand, participants aged between 35 and 44 years had the highest mean consumption of thyme pie (89.5 g/day), whereas, the lowest consumption of thyme pie was among participants aged between 18-24 years (64.3 g/day) (Table 6).

	Consumption of each food item (g/day)					<i>p</i> value	Gender		<i>p</i> value
	Adults Age (years)						Male	Female	
	18-24	25-34	35-44	45-59	>60		Mean±SD	Mean±SD	
TP	64.3±99.9^a	76.4±135.6 ^{a,b}	89.5±131.0^{a,b,c}	72.5±84.0^{b,c,d}	69.9±86.6^{a,b,c,d}	0.008*	97.5±133.8	53.3±81.4	<0.001*
CTP	63.1±95.4	47.6±86.0	52.3±79.8	50.6±67.3	55.6±71.2	0.366	66.6±91.6	45.0±78.0	0.001*
FTS	47.7±89.6^a	58.1±118.1^{a,b}	67.3±87.3^{b,c}	81.1±125.5^{b,c}	106.6±153.0^d	<0.001*	70.1±108.5	66.8±120.5	0.824
TRS	12.7±20.0^d	18.2±27.4^{a,b}	15.8±21.1^a	20.5±26.2^c	21.7±27.2^{a,b,c}	<0.001*	19.0±26.0	15.4±22.8	0.023*

TNS	8.9±14.9	11.0±15.7	12.9±20.2	11.4±22.1	16.1±20.8	0.076	13.7±21.8	9.5±15.0	0.013*
PP	28.0±42.0	29.7±37.6	23.3±23.1	23.1±23.6	35.0±57.2	0.639	31.2±42.7	24.6±33.1	0.017*
BS	4.87±8.02	4.8±9.1	7.1 ±21.9	4.3±7.2	5.1±11.6	0.413	4.7±8.1	5.2±12.6	0.137
SB	16.5±38.9	11.0±13.6	9.4±12.1	16.4±30.9	11.4±13.31	0.173	14.0±20.5	13.8±33.3	0.245
CT	4.4±6.6^{b,c,d}	2.7±3.3 ^{a,b,c,d}	3.4±5.2 ^{a,b}	3.5±7.5^a	2.5±3.3 ^{a,b,c}	0.048*	4.0±6.8	3.5±5.6	0.768
TB	8.5±19.8	5.0±13.1	3.7±10.5	7.0±13.7	6.6±9.0	0.360	5.5±13.4	7.2±16.2	0.067
TC	11.6±25.7	9.2±13.7	10.0±18.4	7.5±10.2	5.8±6.9	0.285	13.3±25.3	6.7±11.1	<0.001*
TCY	20.2±37.8^{a,b}	28.4±85.2 ^{a,b,c}	14.5±22.2^a	16.2±22.5^{b,c,d}	27.4±45.9^{c,d}	0.012*	24.3±41.4	18.2±52.2	0.196
HMC	41.4±74.1	68.0±127.0	68.2±157.1	73.1±126.4	71.5±154.6	0.064	68.0±141.7	57.8±109.5	0.292
TT	49.32±75.58	51.03±74.41	37.80±66.94	53.87±73.22	70.37±104.28	0.491	47.6±75.0	56.4±81.4	0.678

Table 6 Mean consumption (g/day) of thyme products by different age groups and gender (n=1523)

* $p < 0.05$ is considered significant

¹Mean consumption values are expressed in grams per day

²SD: Standard Deviation

Columns with superscripts **without** a common symbol differ, $p < 0.05$

TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

Our study showed that older persons consumed healthier thyme products (fresh thyme salad, thyme sandwiches) compared to the younger age groups (thyme pie, crackers). A healthy dietary pattern/food choice among old populations (45-54 years old) was similarly observed in a total diet study for the urban population living in Beirut, Lebanon (Nasreddine et al., 2006). Also, a high consumption of herbs and spices was observed among persons aged between 50 and 60 years in Poland since they could this way substitute table salt and consequently regulate blood pressure (Assimiti D. 2020, Gajewska et al., 2020). Furthermore, a fast-food/dessert dietary pattern was mainly observed among young age groups in Lebanon confirming our findings (Naja et al. 2013).

Consumption of thyme pie, cheese and thyme pie, thyme regular mix sandwich, thyme mix with nuts sandwich, pizza and pasta with thyme, thyme croissant significantly differed between gender groups ($p < 0.05$) with a higher consumption among male

participants (Table 7). This significant difference was related to larger portion sizes and quantities consumed among males as compared to females. In addition, the listed thyme products belong to high caloric groups yielding between 450 and 750 kcal per portion size (Mahan, L. K. & Escott-Stump, S., 2014). This can be related to the higher focus of women on the caloric value of food, weight loss and healthy eating (Crane et al., 2017, Bärebring et al., 2020, Overcash & Reicks, 2021). Similar results were reported by Nasreddine et.al, (2006), who found that males in Lebanon reported higher mean energy intake than females. Also in Lebanon, another study conducted by Yahia et al. (2008) reported that being overweight is more common among males than in females (37.5 vs. 13.6%, respectively). On the other hand, Dehghan et al. (2005) reported that females in UAE had higher BMI value than males highlighting the effect of the dietary pattern differences in different countries

3.5- Geographical location

Consumption of thyme pie (56.1 g/day), cheese and thyme pie (43.4 g/day), thyme mix with nuts sandwich (7.4 g/day), pizza and pasta with thyme sauces (23.4 g/day), thyme croissant (6.9 g/day), Toast/bread with thyme (5.5 g/day), homemade or catering recipes with thyme (40.4 g/day), tea thyme (38.2 g/day) significantly differed between areas of residence with a lowest consumption among participants located in Mount Lebanon. Thyme pie (108.5 g/day), cheese and thyme pie (76.4 g/day), thyme croissant (16.6 g/day) and toast/bread with thyme (12.1 g/day) had the highest consumption among participants living in South. Also, homemade or catering recipes with thyme (163.5

g/day) and tea thyme (104.0 g/day) had the highest consumption among participants living in North, while thyme mix with nuts sandwich (26.4 g/day) had the highest consumption among participants living in Bekaa and pizza/pasta sauces with thyme (34.9 g/day) among participants living in Beirut (Table 7).

In addition, the consumption of thyme regular mix sandwich, and traditional molded aged cheese with thyme/traditional strained yogurt balls with thyme significantly differed between areas of residence ($p < 0.05$); with a lowest consumption among participants located in Beirut (11.4 g/day, 15.7 g/day, respectively) and the highest consumption was among participants living in North (23.6 g/day), Bekaa (33.0 g/day), respectively. Furthermore, sesame thick bread with thyme had the highest consumption among participants living in Beirut (25.2 g/day) and the lowest consumption in Bekaa (9.7 g/day). Finally, fresh thyme herbs had the highest consumption in Bekaa (103.3 g/day), the lowest in North (55.7 g/day) (Table 7).

Table 7 Mean consumption (g/day) of thyme products by area of residence for consumers (n=1523)

Thyme products	Consumption of each food item (g/day)								
	Areas								
	Mount Lebanon	North	Beirut	South	Bekaa		Urban	Rural	
	Mean ¹ ±SD ²	Mean±SD	Mean±SD	Mean±SD	Mean±SD	<i>p</i> value	Mean±SD	Mean±SD	<i>p</i> value
TP	56.1 ±83.5 ^a	74.2±97.9 ^{b,c}	68.0±88.2 ^{a,b}	108.5±163.9 ^d	73.5±103.5 ^{b,c,d}	<0.001*	66.6±98.9	83.6±126.4	0.013*
CTP	43.4 ±56.6 ^a	58.2±125.1 ^{a,b}	69.9±102.1 ^{b,c,d}	76.4±106.7 ^d	54.8±90.0 ^{a,b,c}	<0.001*	54.7±81.7	56.7±93.7	0.510
FTS	57.8±109.7 ^a	55.7±69.5 ^{a,b}	64.6±86.0 ^{a,b,c}	84.6±148.2 ^{b,c}	103.3±138.6 ^c	<0.001*	57.9±96.4	88.9±144.5	0.001*
TRS	14.3±23.5 ^a	23.6±26.5 ^b	11.4±16.6 ^a	17.9±23.9 ^c	21.3±27.1 ^b	<0.001*	15.5±24.5	19.9±23.3	0.483
TNS	7.4±13.7 ^a	11.3±15.4 ^{b,c}	8.7±15.9 ^{a,b}	11.3±18.1 ^{a,b,c}	26.4±26.0 ^d	<0.001*	8.9±17.0	17.6±19.9	<0.001*
PP	23.4±30.8 ^a	34.9±51.1 ^{b,c,d}	36.5±44.5 ^{a,b,c,d}	25.5±33.1 ^{a,b}	28.9±38.0 ^{a,b,c}	0.033*	24.8±33.9	33.8±44.8	0.007*
BS	3.8±6.8 ^a	4.3±7.9 ^{a,b,c}	3.1±3.6 ^{a,b}	6.2±11.3 ^{a,b,c}	13.5±26.5	<0.001*	4.0±8.2	7.2±15.3	0.005*

SB	12.2±24.3^{a,b}	14.9±35.8^a	25.2±53.9^d	13.7±15.4^{c,d}	9.7±9.8^{a,b,c}	0.003*	12.9±28.6	16.5±28.2	0.183
CT	3.1±5.9	4.4±6.7	4.4±7.6	4.2±5.1	3.6 ± 3.9	0.321	3.6±6.2	3.8±5.7	0.801
TB	5.5±15.8^a	6.3±11.4^{a,b}	4.9±7.7 ^{a,b,c,d}	12.1±18.5^{c,d}	9.2±13.7 ^{a,b,c}	<0.001*	6.4±16.8	6.9±9.8	0.619
TC	6.9±10.4^a	10.5±17.3^{a,b,c}	7.7±9.6^{a,b}	16.6±34.2^e	10.2±18.3^{b,d,e}	<0.001*	9.1±19.4	10.9±18.1	0.271
TCY	16.6±37.0^{a,b}	24.8±41.5^{a,c,d}	15.7±27.5^{a,b,c}	17.1±30.2^a	33.0±83.6^d	<0.001*	18.1±33.4	26.1±66.5	0.075
HMC	40.4±77.3^a	163.5±241.4^{b,c,d}	52.0±69.2^{b,c}	46.9±78.4^{a,b}	114.3±187.1^d	<0.001*	43.8±79.4	108.1±187.5	<0.001*
TT	38.2 ±62.9^a	104.0±108.0^{b,c,d}	80.7±91.8^{b,c,d}	77.4±89.0^{b,c}	44.0±81.3 ^{a,b}	0.002*	52.9±80.7	52.4±75.4	0.616

¹ Mean consumption values are expressed in grams per day

² SD: standard deviation

* $P < 0.05$ is considered significant

Columns with superscripts **without** a common symbol differ, $p < 0.05$

TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

Consumption of thyme pie, fresh thyme salad, thyme mix with nuts sandwich, pizza and pasta with thyme, bread sticks with thyme and homemade/catering recipes with thyme significantly differed between areas of residence ($p < 0.05$) with a higher consumption among participants living in rural than urban areas (Table 7).

The higher consumption of several thyme products can be due to the wider availability of food channels in urban than in rural areas offers a variety of food choices over the classic ones. This fact was highlighted by Kosaka et al. (2018). Similar results were reported by a report released by the Food and Agriculture Organization (2017) in Lebanon, which found that participants living in urban areas replaced traditional dishes by a westernized diet consisting of fast-foods and ready to eat meals. Also, it reported that different areas represented multiple variations in food preparation recipes (FAO,2017).

Another explanation can be the fact that in the Bekaa area, dairy production is flourishing, and thus more consumption of dairy with thyme is evident and find a ref that talks about this for sure.

In Iran, a semi-quantitative FFQ showed that urban women had significantly higher score for western pattern than rural areas (Rezazadeh et al. 2020). In Morocco, a high consumption of spices, condiments and herbal teas was observed among participants living in rural areas due to its traditional value and meaning. Moreover, several differences in dietary habits between different areas were shown (Anzid et al.,2009).

3.6- Socio-economic Status (educational levels and household incomes)

Mean consumption values among consumers with different educational levels and monthly household incomes are shown in tables 8 and 9.

Consumption of thyme pie, cheese and thyme pie, fresh thyme salad, thyme regular mix sandwich, sesame thick bread with thyme, and thyme croissant significantly differed between different educational levels ($p < 0.05$) with the highest consumption among participants of elementary level (10.8 g/day, 89.4 g/day, 22.4 g/day, 19.3 g/day, 12.9 g/day, respectively). The lowest consumption was among postgraduate participants for thyme pie (54.8 g/day), cheese and thyme pie (28.6 g/day), thyme croissant (6.5 g/day) and among participants with technical background for fresh thyme salad and sesame thick bread with thyme (10.7 g/day). As for homemade or catering recipes with thyme, the highest consumption was among participants of postgraduate level (81.3 g/day) and the lowest among participants with elementary level (50.7 g/day) (Table 8).

Table 8 Mean consumption (g/day) of thyme products by consumers with different educational levels (n=1523)

Thyme products	Consumption of each food item (g/day)				p value
	Education Level				
	Elementary school	Technical/high school	Bachelor	Postgraduate	
	Mean ¹ ±SD ²	Mean±SD	Mean±SD	Mean±SD	
TP	104.8±134.0 ^b	80.4±131.8 ^c	63.6±95.5 ^a	54.8±66.6 ^a	<0.001*

CTP	89.4±120.2^b	54.6±62.6^{a,b}	52.8±89.8^a	28.6±36.5^c	<0.001*
FTS	89.9±128.0^c	60.6±101.0^{a,b}	62.5±120.2^a	73.1±103.6^{a,b}	0.001*
TRS	22.4±30.9^c	15.8±22.4^{a,b}	14.8±21.5^a	19.3±26.4 ^{a,b,c}	0.009*
TNS	16.7±22.5	9.8±12.6	10.7±19.4	9.9±17.3	0.131
PP	30.9±45.4	21.3±23.9	29.8±40.8	25.8±35.8	0.108
BS	3.4±6.5	5.1±8.8	4.7±8.3	7.6±22.1	0.672
SB	19.3±37.6^c	10.7±12.3^{a,b}	13.8±26.1^{b,c}	14.2±42.7^a	0.008*
CT	2.4±3.6	4.0±5.6	3.7±5.6	3.8±5.1	0.143
TB	7.3±16.0	4.2±5.9	6.8±14.5	8.9±24.8	0.464
TC	12.9±21.2^c	9.2±25.8^{a,b}	9.9±16.2^{b,c}	6.5±9.9^a	0.005*
TCY	25.0±42.1	18.4±33.5	22.7±61.8	16.3±24.0	0.443
HMC	50.7±86.2^{b,c}	51.2±131.0^a	63.4±126.9^{a,b}	81.3±128.5^c	0.001*
TT	47.6±86.0	46.3±71.2	53.1±77.4	74.3±87.9	0.378

* $p < 0.05$ is considered significant

¹ Mean consumption values are expressed in grams per day

²SD: standard deviation

Columns with superscripts **without** a common symbol differ, $p < 0.05$

TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

Consumption of thyme pie, thyme croissant, cheese and thyme pie, fresh thyme salad, thyme mix with nuts and seeds sandwich, sesame bread sticks with thyme, thyme croissant, tea thyme significantly differed between participants of different household incomes ($p < 0.05$) with a higher consumption among participants that earned <1000\$ per month (90.1 g/day, 43.4 g/day, 53.5 g/day, 14.4 g/day, 9.3 g/day, 7.9 g/day, 13.4g/day) as compared to those with higher incomes () (Table 10). As for crackers with thyme, participants who earned more than 1000\$ per month consumed higher mean intakes (1.2 g/day).

Table 9 Mean consumption of thyme products by consumers with different household incomes (\$) (n=1523)

Consumption of each food item (g/day)			
Household income in \$ ¹			
Thyme products	<1000\$	≥1000\$	<i>p</i> value
	Mean ² ±SD ³	Mean±SD	
TP	90.1±149.9	53.7±85.7	<0.001*
CTP	43.4±92.9	21.2±53.5	<0.001*
FTS	53.5±120.2	35.1±84.5	0.009*
TRS	14.4±24.3	10.2±20.2	0.004*
TNS	4.1±11.7	3.2±11.2	0.060
PP	14.1±30.1	14.5±30.5	0.800
BS	2.0±6.0	2.1±7.9	0.731
SB	9.3±26.4	5.8±18.9	0.023*
CT	0.8±2.8	1.2±4.0	0.011*
TB	1.4±6.8	1.5±8.1	0.693
TC	7.9±24.4	3.8±9.3	0.003*
TCY	10.4±25.7	9.0±35.4	0.472
HMC	16.7±50.2	18.9±78.1	0.238
TT	13.4±47.3	7.7±35.0	0.040*

**p*<0.05 is considered significant

¹Each 1\$ is equivalent to 1500 LBP

²Mean consumption values are expressed in grams per day

³SD: standard deviation

Columns with superscripts **without** a common symbol differ, *p* <0.05

TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

Participants with low socio-economic status had higher mean intake for several thyme products than the ones with higher status because thyme is considered a traditional food item, available at affordable/cheap prices and has a long shelf life when it is in its dry form (UNDP, 2018). In addition, those participants were less selective for the healthy version of some thyme products and consumed more ready-to-eat or junk items (such as pies, croissant, thick bread). Similar results were reported by Naja et al., 2013 in Lebanon, who found that eating habits are related to the socioeconomic status of individuals since their food choices are based on financial constraints and

obstacles. In Europe, a study done by Biesbroek et al. (2018) showed that people with low socioeconomic status had a high mean score to consume a traditional diet, while participants with high socio-economic status tend to have high mean scores for prudent diet (includes fish, nuts, fruits, vegetables, low fat dairies). In the US, a study done by Kell et al., 2015 showed that people with low socioeconomic status had limited food item choices due to purchasing difficulties (Kell et al., 2015).

3.7- Children consumption

Interviewed parents provided information about thyme products consumption of 143 children (less than 18 years old) with an average age of 8 years old and average weight of 33 kg (Table 10).

Thyme pie was the most consumed (80.4%, n=115) and tea thyme was the least consumed product(8.4%, n=12).

Cheese and thyme pie had the highest mean consumption value of 85.2 g/day with thyme contribution of 4.8g/day, followed by thyme pie (77.6g/day) that had the highest thyme contribution of 11.1g/day. Whereas crackers with thyme represented the lowest mean consumption (2.8 g/day), as well as the lowest thyme contribution (0.2 g/day). Our results showed that children had similar trend in consumption as their parents with higher amount of cheese and thyme pie intake. In addition, Lebanese consumers refer to thyme products as memory enhancing and they are embedded in our culture that school students consume thyme in order to perform better in their exams. Similarly, local cheese was the most consumed food item among children and adolescents in South America (Saravia et al., 2018).

Several thyme products are convenient meals for schools (shelf-stable), afternoon snacks or even as a diner. Children choices are affected by their parents so it could be important that parents favor a healthy nutritional education for their children (Isacco et al., 2010). Moreover, In New Zealand, a cross-sectional survey showed that children were influenced by the diet of their parents especially those aged between 9 and 12 years since they consumed most of their meals at home (Davison et al., 2017). In Europe, children dietary patterns were in alliance with their mothers unrestrained by the meals prepared by her (Hebestreit et al., 2017). Moreover, mothers with high educational level can positively affect a healthy dietary pattern for their children, while children of mothers with low educational level tend to consume high sugary and fat snacks (Smithers et al. 2012).

Despite the relatively lower amount of data collected about children, the observed trend is worth further investigation and analysis in future studies.

Table 10 Characteristics of children participants, % of consumers and mean consumption (g/day) of thyme products (n=143)

	Minimum	Maximum	Mean¹±SD²
Age	1.5	17	8.5±5.0
Weight (Kg)	11	60	32.6±14.5
Consumption (g/day)			
Thyme products	% consumers (n)	Mean±SD	Thyme contribution per food item (g/day)
TP	80.4 (115)	77.6±92.3	11.1
CTP	31.5 (45)	85.2±132.4	4.8
FTS	32.9 (47)	60.0±80.4	2.1
TRS	62.2 (89)	18.1±18.9	5.6
TNS	21.0 (30)	15.1±13.3	5.2
PP	46.9 (67)	35.6±60.0	0.4
BS	43.4 (62)	3.4±6.7	0.4
SB	48.3 (69)	19.1±33.5	1.3

CT	27.3 (39)	2.8±6.4	0.2
TB	16.1 (23)	5.6±6.0	0.2
TC	39.2 (56)	9.9±20.3	0.9
TCY	31.5 (45)	24.0±47.4	0.3 1.8
HMC	14.7 (21)	64.7±81.3	1.1
TT	8.4 (12)	43.4±70.4	0.4

¹Mean consumption values are expressed in grams per day

²SD: standard deviation

TP: Thyme pie, CTP: Cheese and thyme pie, FTS: Fresh Thyme salad, TRS: thyme regular mix sandwich, TNS: Thyme mix with nuts and seeds sandwich, PP: Pizza/Pasta with thyme sauces, BS: Bread sticks with thyme, SB: Sesame thick bread with thyme, CT: Crackers with thyme, TB: Toast/Bread with thyme, TC: Thyme croissant, TCY: Traditional strained yogurt balls with thyme, HMC: Homemade or catering recipes with thyme, TT: Tea thyme.

Limitations :

FFQ is susceptible to memory and recall biases. Also, due to COVID-19 pandemic and to the current economic crisis that Lebanon is facing, thyme consumption might have changed taking into consideration that thyme is a local product and its price didn't increased much. Therefore, more research is needed in order to assess the impact of this crisis on thyme and thyme products consumption.

Further studies can use dietary records and recalls as reference methods in order to validate this questionnaire.

3. Conclusion:

This study showed that almost all the participants consumed thyme products with the highest mean intake for thyme pie and the least mean intake for crackers with thyme. Also, this study permitted to assess the variation in consumption patterns of thyme products in Lebanon between different socio-demographic, economic factors, age and gender.

The use of FFQ can be a useful approach for estimating thyme products intake, since it is based on assessing both the quantity and frequency of thyme products consumption. This approach is needed for investigating dietary intake of thyme products and health outcomes relationships, such as estimating the risk assessment of chemicals and food contaminants that could be consumed through thyme products.

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Appendices

Food Frequency Questionnaire used to assess thyme consumption in Lebanon:

Consumption of the Thyme Products in Lebanon: Food Frequency Questionnaire

The aim of this study is to assess the Lebanese population's consumption and preferences for buying thyme and different thyme products.

PART A (to be filled by the respondent. On form can be filled by the interviewer)

Please circle the choice(s) that best describe your situation or answer the questions as indicated

Part 0: Data Entry (To be filled by data entry operators)

1. Name of respondent: _____
2. Questionnaire code: (initials of the interviewer followed by a unique number)
3. Date of data collection: _____

Part 1: Socio-Demographic and Economic Status

1. Gender:
 1. Male
 2. Female
2. Age: _____
3. Body weight: _____
4. Marital status:
 - 4.1. Single
 - 4.2. Married/divorced WITHOUT children
 - 4.3. Married/divorced WITH children
5. How many children do you have?
 - 5.1. None
 - 5.2. 1
 - 5.3. 2
 - 5.4. 3
 - 5.5. 4
 - 5.6. More than 4

9. Where do you live?

- 9.1. Mount Lebanon:
 - 9.1.1. Urban
 - 9.1.2. Rural
- 9.2. Other (specify):
 - 9.2.1. Urban
 - 9.2.2. Rural
- 9.3. Bekaa Valley:
 - 9.3.1. Urban
 - 9.3.2. Rural
- 9.4. South (specify):
 - 9.4.1. Urban
 - 9.4.2. Rural
- 9.5. Bedouin (specify):
 - 9.5.1. Urban
 - 9.5.2. Rural

10. What is your primary religion?

- 10.1. Christian
- 10.2. Muslim
- 10.3. Palestinian
- 10.4. Other (specify): _____

11. What is your highest education level?

- 11.1. High school
- 11.2. Technical high school
- 11.3. Bachelor (University)
- 11.4. Doctorate/Postgraduate

12. What is your monthly net income (after tax and social insurance deduction)?

- 12.1. Less than 700,000 L.L.
- 12.2. 700,000 - 1,999,000 L.L.
- 12.3. 2,000,000 - 2,999,000 L.L.
- 12.4. 3,000,000 - 4,999,000 L.L.
- 12.5. More than 4,500,000 L.L.

PART B:**Consumption of the Thyme products in Lebanon: Food Frequency Questionnaire****PART B (if the participant has kids below 18, please fill this form for the participant and fill a separate form for every child)***Questionnaire code: (initials of the interviewer, followed by #):.....*

The below table is filled for: -adult OR -child,specify

age:.....and weight.....

Part C:

	A. Frequency <i>*m:month/ wk:week</i>									B. Quantity of standard portion consumed at a time <i>*refer to the appendix A</i>	C. Exceptional Consumption			D.sources 1-supermarkets (specify brand, check appendix B) 2-small shops (specify) 3-restaurants (specify) 4-village/homemade/monastery (specify) 5-bakeries (please specify, check appendix C below) 6- others (specify)
	Never	<1/m	1/m	2/m	3/m	1/wk	2/wk	>2/wk (specify)	Daily		N=	Frequency	Standard portion	
Standard Reference Portion Pictures Are provided Below (Appendix A)														
Manooushe only zaatar														
Manooushe cheese +zaatar														
Zaatar Herbs (Thyme main ingredient)														
Zaatar Mix Normal (Sandwich)														
Zaatar Mix Extra with Nuts, seeds... (Sandwich)														
Pizza and Pasta sauces with Thyme														
Kaak bi Zaatar (crunchy)														
Kaak bi Zaatar (soft)														
Crackers with zaatar														
Toast/bread with zaatar														
Croissant zaatar														
Chanklish & Labneh with zaatar														
Homemade or catering recipes (marinade meat with zaatar, salads,potatoes)														
Tea with Thyme														

Appendix A Standard Reference Portion Pictures



1 medium zaatar



1 medium zaatar+cheese



1 cup of zaatar herbs



1 Tbsp normal thyme/mix/with nuts and seeds



1 medium crunchy kaakbi zaatar



1 small crunchy kaake zaatar



1 medium soft kaake zaatar



1 medium piousa

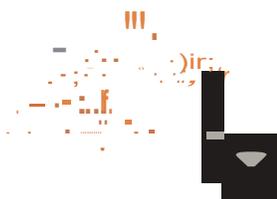


1 plate of pasta

1 small zaatar cracker



3 sizes of Croissant:



1 big crois-sant zaatar



1 medium croiSS-ant zaatar



1 mini crois.-ant zaatar



1 normal zaatar
toast/bread



1 ball chanklish



1 small balls
labneh



1 sachet tea with
thyme



1 Tbsp tea with
thyme

Appendix B Brands suggestions for packaged Zaatar

Brands suggestions for packaged zaatar

- a. Garde -a
- b. Ductos
- c. sa..oum &ros.
- d. Alwachi Akhdar
- e. Maymour.e
- f. AOIn g.
- g. Deta
- h. Lepotager
- i. t-1xrbra
- j. Intajovna
- k. A"berto
- l. Adonis
- m. Abido
- n. Ostilty
- o. &ab Alsa am
- p. Petra
- q. Others

Appendix C Bakeries suggestions

Bakeries suggestions

- a. Wooden Bakery
- b. Moulin D'or
- c. Yasmine Bakery
- d. Al chayeb
- e. Al shami
- f. Furn Beaino
- g. Keyrouz Bakery
- h. Chamsine Bakery
- i. Pain D'or
- j. Dagher Pastry and Bakery
- k. Khebz Al Sultan Bakery
- l. Atallah Bakery
- m. Furn Bechara (Antelias)
- n. Paul
- o. Magnolia Bakery
- p. Délifrance
- q. Others

Supplemented Materials: