Quality Assessment of Five Common Types of Green Tea in Benghazi Markets

ABSTRACT

Green Tea is one of the most widely consumed beverages worldwide, with green tea gaining popularity due to potential health benefits. Consuming too much green tea daily could have adverse effects. Following the consumption of a high dose of green tea extract, several complications and negative effects can be observed, the consumption patterns and habits of the consumer in the tea market are influenced by a variety of factors, including psychological factors behavioural factors descriptive factors marketing. Cross-sectional study was conducted among 500 participants selected randomly from different areas in Benghazi, Libya. A validated questionnaire assessed demographics, knowledge, attitude, and practices about green tea. Five commonly consumed green tea brands were selected from local markets and brewed for different durations (Soaking, 10, 20, 30, 60) min at constant temperature 100. Samples were analysed for physicochemical parameters and compared with Libyan standard specification for green tea. The relationship Between Socio-Demographic Factors and the Knowledge, Attitude, Practice About Green Tea, was modelled using, statistics package social sciences (SPSS). There was significant relationship between the number of times drink green tea and income (p=0.021). Also, association between believing green tea is good for children and education level (p=0.000). Standard requirements and explanatory data of the sample were close from the standard specification for tea. The studied samples achieved a good level of quality in all measured physical and chemical properties comparing to the Libyan standard specification for tea. When analysing the samples, it noticed that the caffeine values in all samples increased with brewing duration. While the value of tannin in green tea reached the highest concentration value at 20 minutes, except for sample E, at 30 minutes. Most participants were aware of the health benefits of green tea but lacked knowledge of potential side effects. There is a high level from children don't drink green tea. Tea sample quality varied from brand according to parameters like moisture, ash, and fibre content. Caffeine content increased with longer brewing time, tannin start to decrease when brewed for more than 20 minutes.

Key word: Green tea, Quality of tea, Caffeine, Tannin, Consumption of green tea.

1-INTRODUCTION:

The most popular manufactured beverage consumed worldwide is tea (Camellia sinensis). It is one of the oldest beverages in the world, having been discovered around 2700 BC. Currently, it comes in six main kinds depending on the oxidization and fermenting process used[(1)]. Based on the degree of oxidation of Camellia Sinensis, tea can be classified into three main categories: green (unfermented), oolong (partially fermented), and black (fermented)[(2)]. Where is green tea accounts for 20% of all tea consumed globally[(3)]. While some types of tea may endure the marine climates of the British mainland and the Washington region of the United States, the tea crop has relatively precise agro-climatic requirements that are only available in tropical and subtropical climates. Tea plants require a hot, humid atmosphere. Its specific requirements are temperatures between 10 and 30 ◦C (zone 8 climate or warmer), a minimum of 1250 millimetres of annual precipitation, acidic soils, optimal slopes of 0.5 to 10, and altitudes up to 2000 meters. Since to its sensitivity to changes in growth conditions, tea production is geographically restricted to a few numbers of regions worldwide. In addition, it faces a considerable danger of having its perfect growing conditions altered by climate change. The green tea comes in three different forms: tea leaves (also known as loose leaf tea), powdered tea, and tea bags[(4)]. The green tea comes in three different forms: tea leaves (also known as loose leaf tea), powdered tea, and tea bags [(4)]. And for the synthesis of tea, keep in mind the following components level of the moist load of the leaves and according to assortments, water makes up between 75 and 77.5% of the dry weight, followed by tannins: 2-4%, caffeine: 1-4.8%, essential oils: 0.02%, protein 12-20%,

carbohydrates: 3-4%, minerals: 4-5% of dry weight counting aluminum, manganese, magnesium, phosphorus, sulfur, zinc, copper, calcium and potassium , yeasts and nutrients: B6, B2, B1 bunch (around 600 mg), and others[5]. The consumption patterns and habits of the consumer in the tea market are influenced by a variety of factors, including psychological factors (consumption motivation, needs, and pleasure), behavioral factors (culture of life, frequency of consumption, number of cups consumed, method of preparation, and location of consumption), descriptive factors (gender, age, professional activity, family size, residence, and economic situation), and marketing factors (pricing and advertising)[6]. Overall tea is considered as a essential part of the daily diet and has been recognized as a "pro-health habit"[7,8]. Nevertheless, consuming too much green tea daily could have adverse effects. Following the consumption of a high dose of green tea extract, a number of complications and negative effects can be observed, including gastrointestinal disturbances, heartburn, cardiovascular problems and others [9].

The term of "tannin" is derived from the French word "tannin" (tanning substance) and refers to a class of natural polyphenols[14]. Tannins are complex, astringent, and water soluble phenolic compounds that have been shown to reduce nutrient bioavailability[12]. Moreover, tannins, when consumed through foods, reduce the digestibility of the nutrient, but they can be reduced to a significant level by several domestic processing treatments such as soaking, germination, cooking etc. [15,16,17]. Caffeine, an alkaloid of the methyl xanthine family, is found naturally in the leaves, seeds, and fruits of over 63 plant species worldwide[18]. For instance, while coffee is the primary source of caffeine in North America and many European countries, tea is the preferred caffeine-containing beverage in many Asian countries. Caffeine is also found in cola beverages and energy drinks, which are popular globally and often, constitute the primary source of caffeine in younger people [19,20].

The Libyan standards are concerned with the requirements that all types of tea, including green tea, which is used for making tea drinks and is scientifically known as Camellia sinensis, must meet. The standards have written by the technical committee specialized in the field of formed commodities and plant products in 2008, and it takes place of the 2002 Libyan Standard Specification (No. 396). A several studies have been done on consumer preferences for green tea worldwide. Mailud El-Amari and others conducted a study in (Al-Arab medical university) Benghazi - Libya (2009), the purpose of this survey was to study the knowledge, attitude, and practice of 600 students about the use of green tea. Where 85.9% of student were drinking tea, the main characteristic of the study sample. Green tea is known to have beneficial effects by 77.5% of the students investigated. 9% of the students investigated are aware of the negative effects, while 12.8% are not. 3.7% of people prefer to drink tea without sugar. Tea with sugar is preferred by 88.7% of people [21]. In addition, another study conducted in 2018 by G. Sneha was aimed to understand youth awareness of green tea use by a questionnaire study. 200 participants were given pretested interview questionnaires, with the focus being on young people in Chennai between the ages of 18 and 25. Almost 51% of participants said they often drank green tea and felt calm, 48% said it helped them lose weight, and 45% said it aided their digestion. 87% of the people were aware about green tea and 51% of the people consume it on a regular basis. 13% of the people were completely unaware about green tea 30% of them reported drinking 1cup/day is healthy, 42% felt 2cups/day,48% of them came to know about green tea via advertisements, 28% by newspapers, 12% each via word of mouth and Internet [22]. The quality of tea can be an overall evaluation of a product quality most generally refers to a degree of excellence or finesse frequently in conformance to apre-established standard (27). Shatta (1999), study aimed to evaluate some green tea brands in the light of quality standards of different countries. The study dealt with some quality attributes of the green tea marketed in Egypt, Libya, Canada, USA, and Spain under different brands of Japanese and Chinese sources. All the chemical and microbiological determinations were carried out according to Egan et al (1981). Finally, the Japanese samples were superior to Chinese one, regarding water-soluble ash and acid-insoluble ash and tannins. The Chinese teas was superior to the Japanese regarding alkalinity of water soluble ash [26]. However, another Study did by Jing et al., (2019) this study aimed to evaluate the effect of storage temperature on the alteration of the sensory quality of tea. Huangshan Maofeng tea was stored at - 80C°, - 20C°, 4C°, or room temperature for up to 150 days. In conclusion, Huangshan Maofeng tea stored at - 80C°, and - 20C°, exhibited a comparable leaves appearance as tea before storage. Storage of tea at room temperature and 4C°, resulted in a color loss of tea leaves. [28].

Since there are regional variations in the methods that tea is brewed around the world, numerous studies have shown that these variations can be affected the total flavonoid content, phenolic contents, and antioxidant activity, which are influencing by the brewing temperature and the length of the brewing process (hot water infusion). As in the (Yan Jin, 2019) study based between Korea & China, which shown that the brewing conditions can have several effects on the metabolic, catechin, and

antioxidant profiles of green tea infusions. Results showed that the antioxidant activities of the different infusions were more dependent on brewing temperature than the brewing time and showed that brewing temperature and time significantly affected metabolic profile changes. There Tea infusions were prepared by brewing 2.0 g of green tea powder in 200 mL doubly distilled water in a 250 mL Duran bottle [(10)].

Many study about extraction methods from green tea in wide world Libyan study have been done by Dr. Amal Rajab and another (2009) study on the percentage of Libyan tannins and caffeine green tea drinks and their nutritional benefits human health research nutritional benefits and Side effects three green tea samples from vert chine chunmee (NAPT) were used for this compositional analysis, the results of the Libyan traditional method can assume that all three Libyans traditional methods performed on green tea samples show health benefits. The traditional method of boiling for 30 minutes is the most common Libyan method contains the highest levels of polyphenols and caffeine. [(35)]. Another Libyan study have been done by Zeahmida and another (2021) compare tannin content in tea samples of (imported) and grown teas found in the market Libya (local) used titration method to prepare tea extract and evaluated tannin qualitatively and quantitatively evaluated tannin. The results showed that the local tannin content was relatively high green tea. Lower levels were found in imported tea samples. that might it can be attributed to the method used to process the imported tea leaves. [(37)]. The current study aims to, study of the Knowledge as well as attitude of green tea consumption among Libyans, including the common practice of tea brewing. Comparing the quality of the most consumed green tea by Libyans that available in the local market with the Libyan standard specification for tea. Find out the best brewing time at which the caffeine in the highest concentration and the tannin in the lowest concentration.

2- METHODOLOGY:

A descriptive cross-sectional study was conducted in Benghazi the second largest city in Libya, carried out from 9 January up to 1 February 2023. To study of Libyan consumer knowledge, attitudes and practices regarding green tea, and to read the label and analyze some of the compounds of green tea and compare it with the Libyan specification of tea. The study was divided into three parts as mentioned. A total of 500 participated was included in the study, the exclusion criteria was only children's less than 18 year. 18 year and more were included male and female, the study subjects were selected randomly from different geographic area in Benghazi.

Study sampling:

Data Collection: In this study, the validated questionnaire has been used based on 19 items divided into three sections knowledge, attitude, and practice. The questionnaires were conducted by direct interview with the subjects. Information such as personal information, demographic and socioeconomic characteristic were collected. In addition, information of their believes and knowledge about benefits and side effects of green tea and methods of tea preparation were also collected.

Preparation of Samples:

The third part of this study consisted of experiments conducted on five samples of green tea that were selected according to the consumption of the sample. The test was performed in 5 infusions for each sample: 5 g of green tea leaves were weighed by a food scale then brewed in 250 ml of bottled water (the solid-to-liquid ratio was according to a pilot study done with 10 random families to determine the ordinary Libyan recipe for brewing green tea). The tea leaves were added to a boiling water 100°C and then brewed for five different time intervals: (i) Soaking only (by adding tea leaves to the boiling water and let them soak). (ii) Boiling tea leaves for 10min. (iii) Boiling for 20min. (iv) Boiling for 30min. (v) Boiling for 1h. Same method were applied for all 5 samples for samples A, B,C,D,E. The samples then filtered through a tea strainer then put the filtered tea in sterile and closed glass containers and saved in the refrigerator at 4°C until they are analyzed.

Fig. 1. Green Tea Samples Immediately After Preparation and Placing in the Refrigerator.

Libyan Specifications of Tea: The Libyan standard for tea is one of the specifications issued by the Libyan Food Control Center, which specifies the requirements that must be met in tea from a technical and laboratory data (which must be met without exception and written down clearly) [13]. Five types of green tea were selected according to the most consumed in Benghazi city. All samples were coded as follows A, B, C, D, and E, and were compared to the Libyan quality specifications for green tea, where the researchers studied several aspects such as: standard requirements, interpretive data, and physical and chemical factors.

Sample (A)

Sample (B)

Sample (C)

Sample (D)

Sample (E)

Fig. 2. Green Tea Samples

Procedures: The procedures of this study in preparation and analysis of moisture, caffeine, crude fiber, tannin, and total ash were done according to Egan H (1981) [38].

Data Analysis:

The data collected was analyzed as descriptive data of all the variable presented in tables and graphs. The package used for the analyses is SPSS 26. A significance testing such as chi-square test (t test) was used to examine relationships of variables. Significance level: $p \leq 0.05$ was statistically significant.

3- RESULT:

A descriptive cross-sectional study was carried out in Benghazi on subject aged 18 years and above (166 male and 334 female). Knowledge, attitude, and practice about their consumption of green tea were studied. Based on our results, the most consumed types of wares selected and compared technically with the Libyan specification for tea. The sample analysed for ash, crude fibre, tannin, and caffeine at different brewing time.

Table 1. Socio-Demographic Characteristics for Study Samples.

variable	Number	Percent%
Gender		
Male	166	33%
Female	334	67%
Total	500	100%
Age		
18-40 year	335	67%
41-60 year	129	26%
Over 60 year	36	7%
Total	500	100%
Marital Status		
Single	265	53%
Married	212	42%
Divorced	10	2%
Widow	13	3%
Educational Level		
Illiteracy	8	1.6%
Primary	1	0.2%
Average Institute	58	11.6%
Prep School	26	5.2%
High School	42	8.4%
University Level and Above	365	71,2%
Number of Family Members		
2-5	192	38%
6-10	283	57%
11-15	25	5%
Monthly Income		

Less than 500 LYD	94	18.8%
500-1000 LYD	183	36.6%
More than 1000 LYD	223	44.6%
Health Status		
Not Good	7	1.4%
Good	282	56.4%
Excellent	168	33.6%
Chronic Diseases	43	8.6%

The data collected from 500 subjects showed that (67%) were female and (33%) male. The age distribution of subjects was ranging between (18-80) years old, the average age (34) years. About (67%) of subjects have age groups between (18-40) years old compared to other groups. (table1).

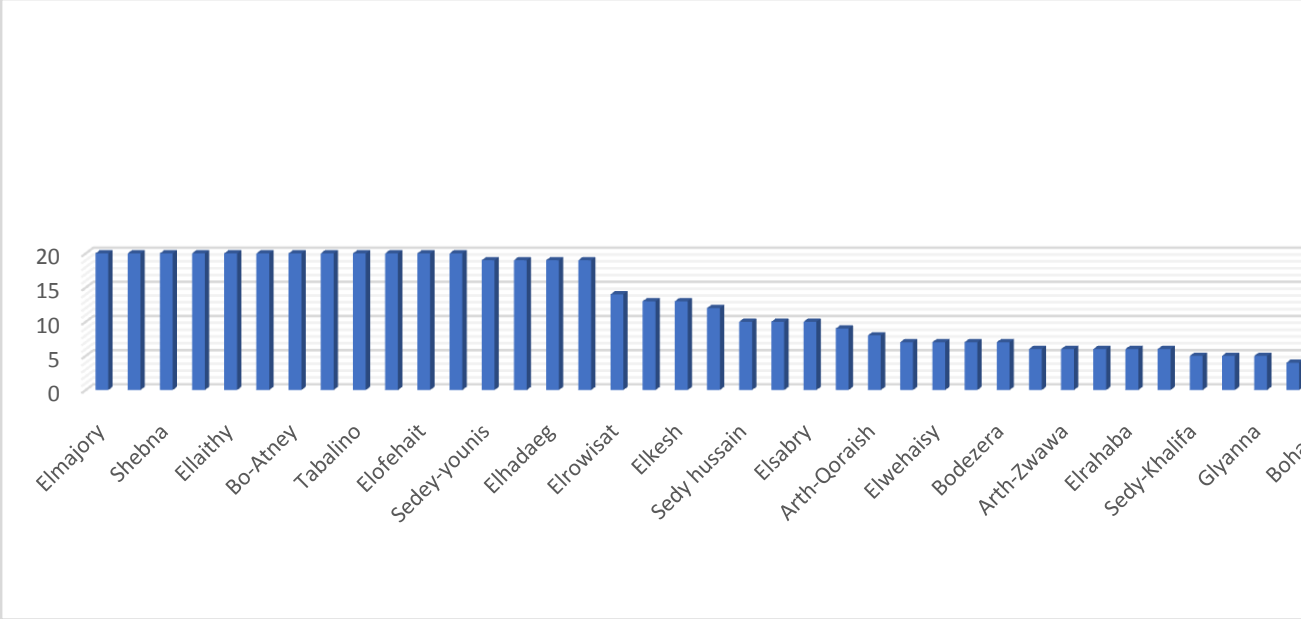


Fig 3. Geographical Distribution of the Sample.

The fig (3), show random distribution of participated answering the questionnaire from most areas of Benghazi city. Figure (4) shows the percentage of drinking green tea, where most subjects (83%) consumed green tea. While (17%) of sample didn't drink it.

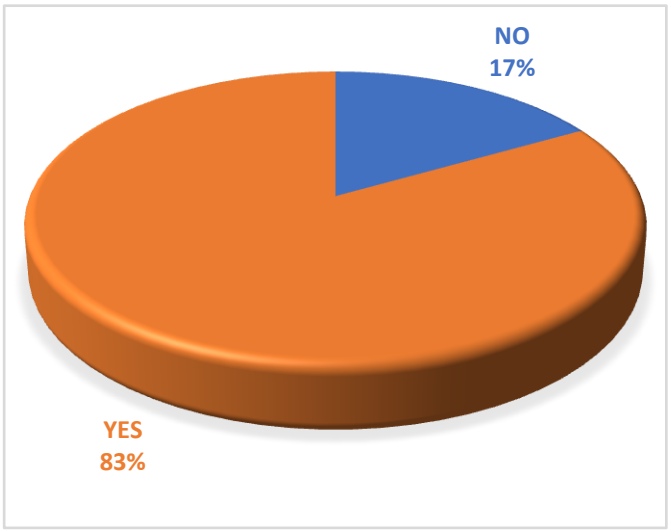


Fig 4. Percentage of Green Tea Drinking of the Sample.

Table2: Distribution of Green Tea Drinking Patterns According to the Gender.

Variable	Number	Male	Female	Percent %
% Green Tea Drinking				
Yes	416	145	271	**83%**
No	84	21	63	**17%**
Reasons to Avoid Drinking Green Tea				
Medical cause	10	7	3	**12%**
No desirable	74	17	57	**88%**
Other	0			**0%**
Preference to Drink Green Tea				
Rarely	56	18	38	**13.4%**
Sometimes	155	47	108	**37.2%**
Often	95	36	59	**22.7%**
Always	110	44	66	**26.3%**
No. of Cups Per Day				
Do not drink it daily	133	37	96	**32%**
1-2 cups	216	37	96	**52%**
3-4 cups	58	81	135	**14%**
5-6 cups	7	3	4	**1.6%**
7 or more cups	2	2	0	**0.4%**

As shown in table (2), a high majority of subjects consumed green tea (83%) where male 145, female 271. While (88%) 17 male, 57 female they not desirable to drink. According to the general distribution of the sample according to their preference for drinking tea, find that (37%). Depending to the preference of drinking tea, the Researchers found that, the number of teas consuming time (52%) drinking (1 - 2) cups per day.

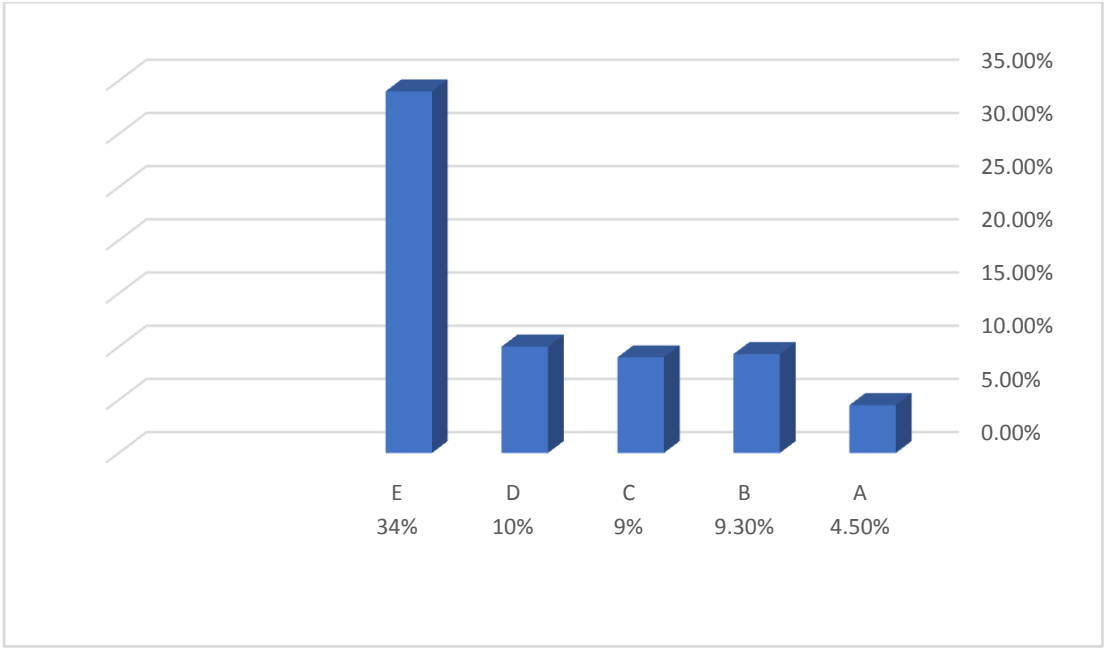
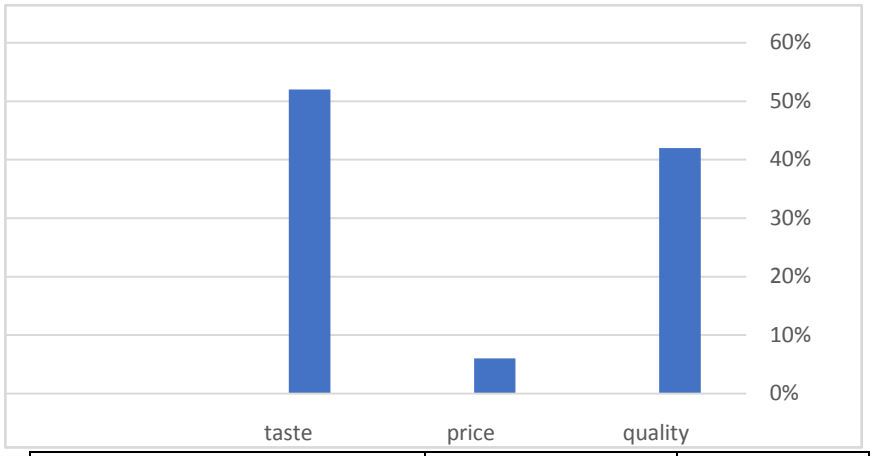


Fig 5. Distribution of Green Tea Brands According to the Consumption.

As described in figure (5), the study sample shows (E) Green tea was the predominant consumed among all brands of green tea drinkers was (34%)..



52%		6%		42%	
M	**F**	**M**	**F**	**M**	**F**
64	151	11	14	70	106

Fig 6. Reasons for Choosing a Particular Brands of Green Tea based of gender

Table 3: The Pattern of Knowledge and Practice About the Green Tea Consumption of Their Sample Children's.

Variable	Number	Percent %
Do Your Children Drinking Green Tea		
Yes	53	26.5%
No	147	73.5%
Age of Children Who Drink Green Tea		
Less than 5 years	9	17%
5 to 10 years	23	43.4%
10 to 15 years	17	32.1%
15 to 17 years	9	17%
Are There Benefits of Green Tea for Children		
Yes	26	49.1%
No	5	9.4%
Do not know	22	41.5%

Regarding the question about do your children's consumption of green tea the researchers found that (73.5%) of children do not drink green tea (Table 3).

Table 4. Beliefs About Cooked Tea.

Variable	Number	Percent %
Did You Drink Green Tea Prepared from the Previous Day		
Yes	102	24%
No	233	56%
Sometimes	84	20%
Storing Tea for a Day in Refrigerator Loses Some Properties such as Flavor and Benefit		
Yes	186	44.7%
No	65	15.5%
Do not know	165	39.6%

Table 5. Specifications of Purchasing Green Tea According the Opinion of the respondents.

Variable	Number	Percent %
Specification that Looks for when Buying Green Tea		
Price	57	12%
Taste	303	62%
Manufactures country	80	17%
Do not know	39	8%
Other	6	1%
The Quality of Green Tea depends on		
Smell	87	14.9%
Test	339	57.9%
Color	157	27%

The specifications that look for when buying green tea, (62%) of participants reported that they look for taste, and the standard of quality, (57.9%) by taste (Table 5).

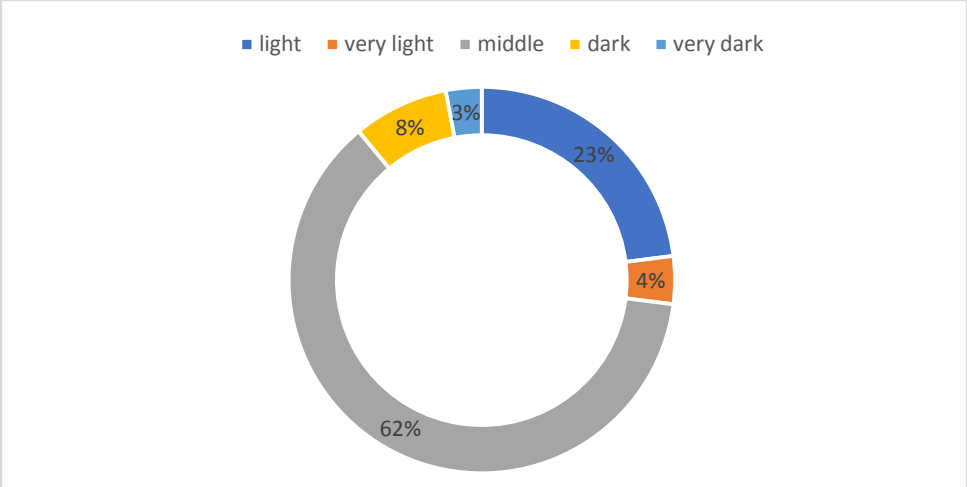


Fig 7. Show sample study colour preference.

Table 6: Knowledge of the Study Sample About Nutritional Green Tea Components, their Benefits and Health Effects.

Variable	Number	Percent%

Nutritional Components		
Antioxidants	216	**48%**
Minerals	25	**4%**
Fluorides	11	**3%**
Vitamin B	27	**6%**
Amino acids	20	**4%**
Do not know	161	**35%**
Benefits		
Increase metabolic rate	214	**43%**
Reduces blood cholesterol level	78	**18%**
Considered antioxidants	132	**20%**
Do not know	85	**19%**
Side Effects		
Yes	130	**31.3%**
No	286	**68.7%**
The Health Problems Related to Side Effect of Green Tea According to Participants Opening		
Gastrointestinal disturbance	22	**15.1%**
Anemia and iron deficiency	96	**65.7%**
Osteoporosis	17	**11.6%**
Other	11	**7.6%**

As shown in the Table (6) the knowledge of the nutritional components of green tea, most participants (48%) reported knowing about antioxidants, and the most reported benefit was an increase in metabolic rate (43%). The majority (68.7%) reported not having any background knowledge. The most reported side effect was anaemia and iron deficiency (65.7%).

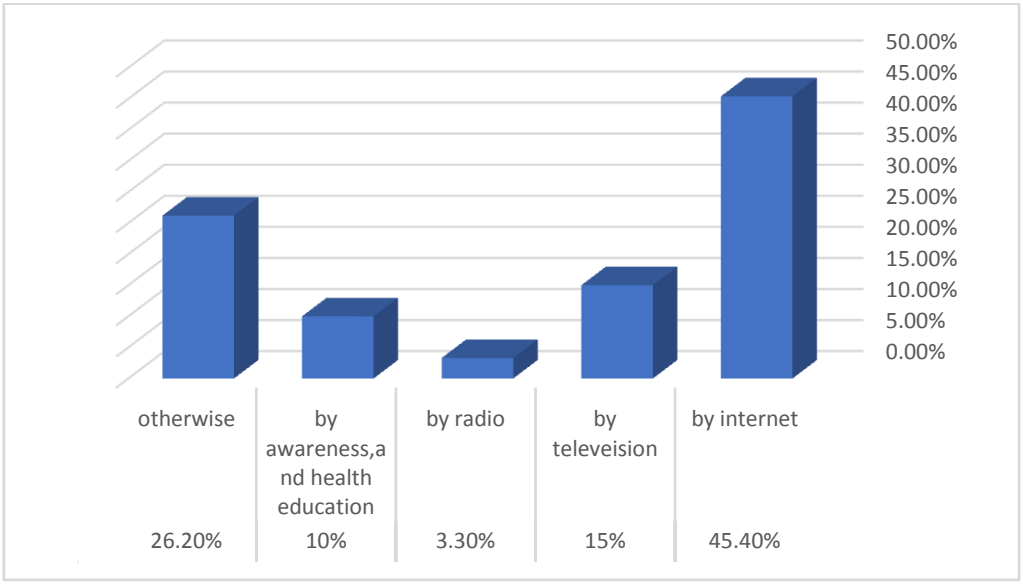


Fig 8. A Source of Participants Information About Green Tea.

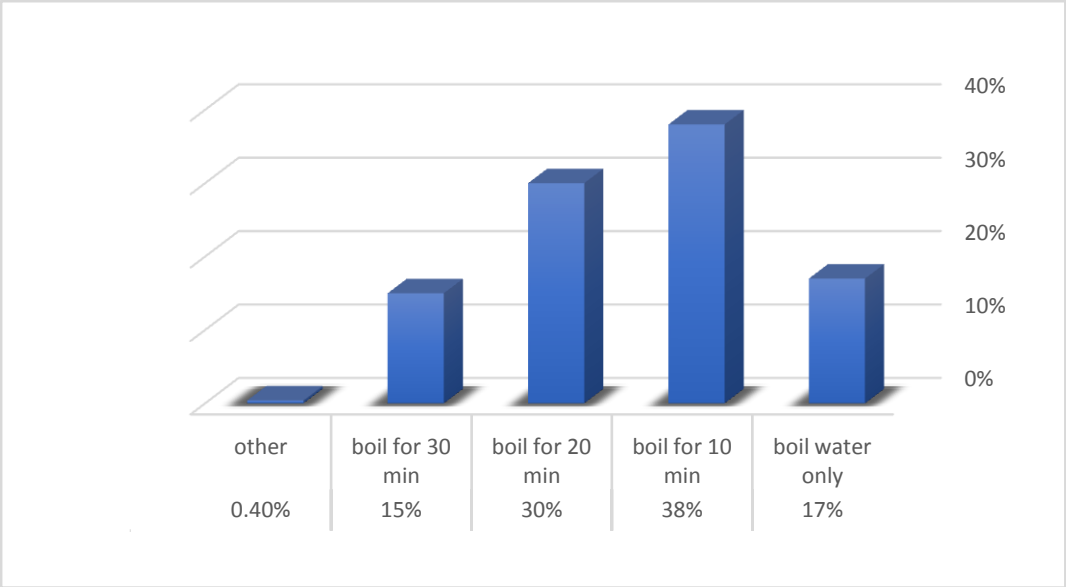


Fig 9. A Sample Study Duration of Boiling Green Tea.

Table 7: Study the Methods of Boiling and Drinking Time of Green Tea for the Participants.

Variable	Number	Percent%
Drinking Time		
In the morning	44	**8.5%**
After lunch	307	**60%**
After dinner	71	**14%**
After trabeculae	85	**16.5%**
Other times	6	**1%**
Additives		
With sugar	219	**53%**
Without sugar	197	**47%**
Boiling Methods		
After boiling the water	141	**33.7%**
Together at the same	275	**66.3%**

Table 8: Associations Between Socio-Demographic Factors and the Knowledge, Attitude, Practice About Green Tea for the Sample Under Study.

Knowledge		
	Variable	**P.value**
Believing that tea is good for children	Marital status	**P=0.000**
	Educational level	**P=0.000**
Knowledge about important nutritional components of tea	Age	**P=0.004**
	Educational level	**P=0.010**
Having information about the side effect of tea	Age	**P=0.035**
Knowledge about and mention the harms of tea	Location	**P=0.005**
Source of information about green tea	Health status	**P=0.000**
Attitude		
	Variable	**P.value**
Preferred type of tea	Location	**P=0.038**
Reason for preferring a particular type of tea	Age	**P=0.008**
	Marital status	**P=0.016**
Specifications they looking for when buying	Educational level	**P=0.000**
	Age	**P=0.002**
The preferred way to prepare tea	Sex	**P=0.004**

Favorite meal for drinking tea	Family members	**P=0.000**
	Educational level	**P=0.000**
Practice		
	Variable	**P.value**
Number of times for drink tea per day	Income	**P=0.021**
Children drinking tea	Marital status	**P=0.000**
	Educational level	**P=0.000**
Brewing tea with or without sugar	Sex	**P=0.018**
Do you drink tea	Marital status	**P=0.172**

Significant association p.value <0.05 by chi-square test

According to table (8) relationships between knowledge and social demographic data. We found that relationship between believing that tea is good for children and marital status P= 0.000 and believing that is good for children and education level P= 0.000. Also, relationship between knowledge about important nutritional components of tea and age association p= 0.004, also with educational level p= 0.010. In addition, there is a relation between having information about the side effects of green tea with the age P= 0.035 and, the relation between knowledge about side effects of green tea and location P= 0.005. Regard sources of information about green tea, we found the relationship with health status P=0.000. As shown in table (8) relationship between attitude and social demographic data. We found the relation between preference type of green tea with location P= 0.038. And the reason for preparing a particular type of green tea with the age P=0.008 and marital state P=0.016. Around specification that looks for buying the green tea, reported relationship with education level P =0.000 and the age P=0.002. Regards the preferred way to prepare tea, we found a relation with gender P=0.004. Also, about favorite meal drinking tea we found relation with family members P=0.000 and education level P=0.000.

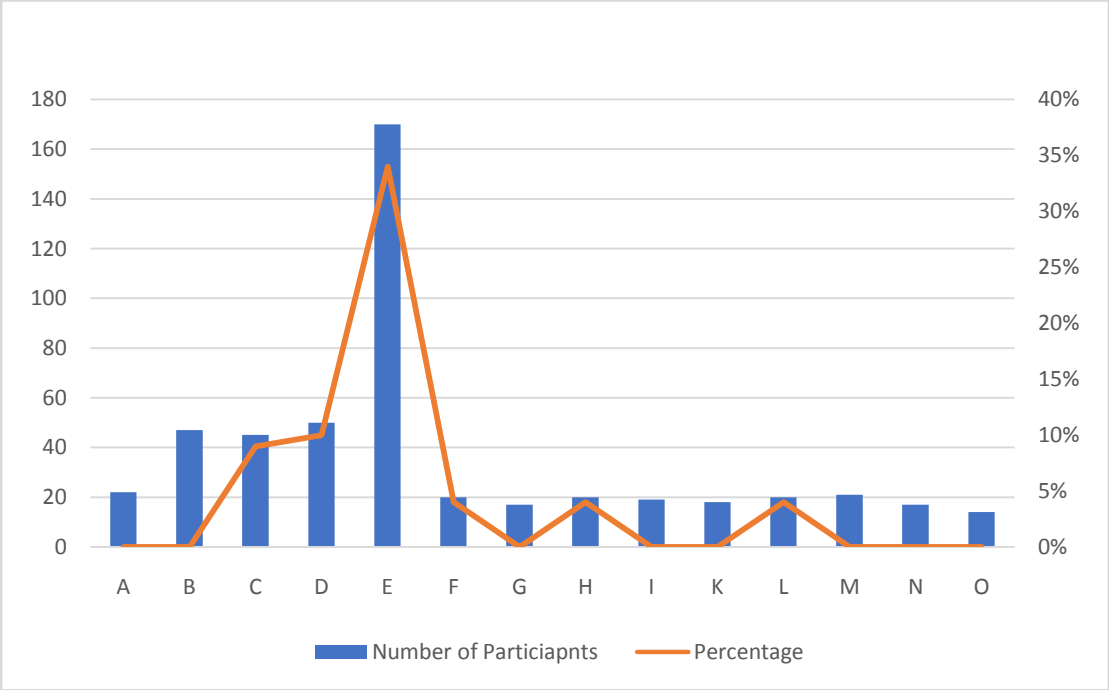


Fig. 10 The percentage of all types of green tea were consumed in Benghazi city, Libya

As shown in Fig 10 the five green tea samples were selected in this study was according to the consumer preferences.

Table 9. The Standard Requirements for Libyan Specifications of Green Tea.

Standard Requirements	A	B	C	D	E
1. Clean and free of impurities.	✓	✓	×	×	✓
2. Free of bad, decayed, or infected parts.	✓	✓	✓	✓	✓
3. Retain the natural characteristics of the type of tea in terms of aroma, color, and taste.	✓	✓	✓	✓	✓
4. Free of additives, except for the items mentioned in 2-3 flavored tea.	*	*	*	*	*
5. The tealeaves should be homogeneous in appearance.	✓	×	✓	✓	×

✓=present ✖=not present. *=not included

According to the required stander requirements, previously explained it was found samples A, B, E were clean and free of impurities, unlike samples C, and D which have impurities. All samples free from infected parts keep natural properties in terms of smell, colour taste. Condition-free additives are not included because our samples are not flavoured tea. We found that most sample leaves were homogeneous in appearance except for samples B, and E which were heterogeneous in appearance as shown in table (9).

Table 10. The Explanatory Requirements for Libyan Specifications of Green Tea.

Explanatory Data	A	B	C	D	E
1. Product name.	✓	✓	✓	✓	✓
2. Factory name, address, and trademark.	✓	✓	✓	✓	✓
3. Country of origin.	✓	✓	✓	✓	✓
4. Net weight of package contents in international units.	✓	✓	✓	✓	✓
5.The type of flavor added in the case of flavored tea	*	*	*	*	*
6. Determine the required storage conditions.	✓	×	×	×	×
7. when adding sugar (sucrose) to fast-dissolving tea	*	*	*	*	*
8. Production and expiry date in month and year and in a non-coded way.	✓	✓	✓	✓	✓
9. Batch number.	×	✓	✓	✓	✓
10. International identification number.	×	✓	✓	✓	✓

✓=present ✖=not present. *=not included

In table (10), our study gets attention to explanatory data we found that all samples have the product name, factory name, trademark, and country of origin the same as net weight, production, and expiry date too. We do not interest in flavoured tea, so the type of flavours has been excluded also for adding Sucrose to fast-dissolving tea. Most samples do not show determine required storage condition on the other hand sample A determines it. For both batch number and International Identification number sample A does not explain.

Table 11. The Physical and Chemical Parameters, Properties That Affect the Quality of Green Tea for The Five Samples Under Study.

	A	**B**	**C**	**D**	**E**
Humidity	7.56%	6.11%	7.44%	6.68%	5.9%
Total Ash	4.1%	7%	3.86%	5.11%	6.25%
Ash Dissolved in Water from the Total Ash	47.2%	56.71%	46.1%	49.59%	51.5%
Alkalinity of Ash Dissolved in Water H2o	1.9%	2.8%	1.3%	2.11%	2.4%
Crude Fiber	11.05%	13.47%	11.99%	11.24%	13%
Caffeine	2.00%	2.24%	1.89%	2.24%	2.91%
Tannin	8.01%	8.95%	9%	8.95%	9.27%
Stem Ratio	7%	4.91%	8.78%	5%	4.88%

As shown in table (11) the results of some important physical and chemical properties that affect the quality of green tea. The level of humidity varied from (5.9%) (E) to (7.56%) (A). The total ash in the studied sample was about (3.86%) (C) to (7%) (B). The value of Ash dissolved in water from the total ash ranged from (46.1%) (C) to (56.71%) (B). The percentage of alkalinity of Ash dissolved in water KOH ranged from (1.3%) (C) to (2.11%) (D). However, the content of crude fibre ranged from (11.05%) (A) to (13.47%) (B). Caffeine is one of the important constituents of green tea. The value of the samples ranged between (1.89%) (C) to (2.91%) (E). According to the tannin content of green tea ranges from (8.01%) (A) to (9.27%) (E). Steam ratio the values ranged between (4.88%) (E) to (8.78) %(C). Caffeine is one of the important constituents of tea. The value specified by the Libyan standardisation ranged 1.5%. The values of the samples ranged between 1.89% (C) to 2.91%(E). According to Libyan standards the tannin content of green tea ranges from 7% to 15%. For the present samples this content varied from 8.01% (A) to 9.27% (E). steam ratio the values ranged between 4.88% (E) to 8.78% (C) while the Libyan standards specify a maximum 10%.

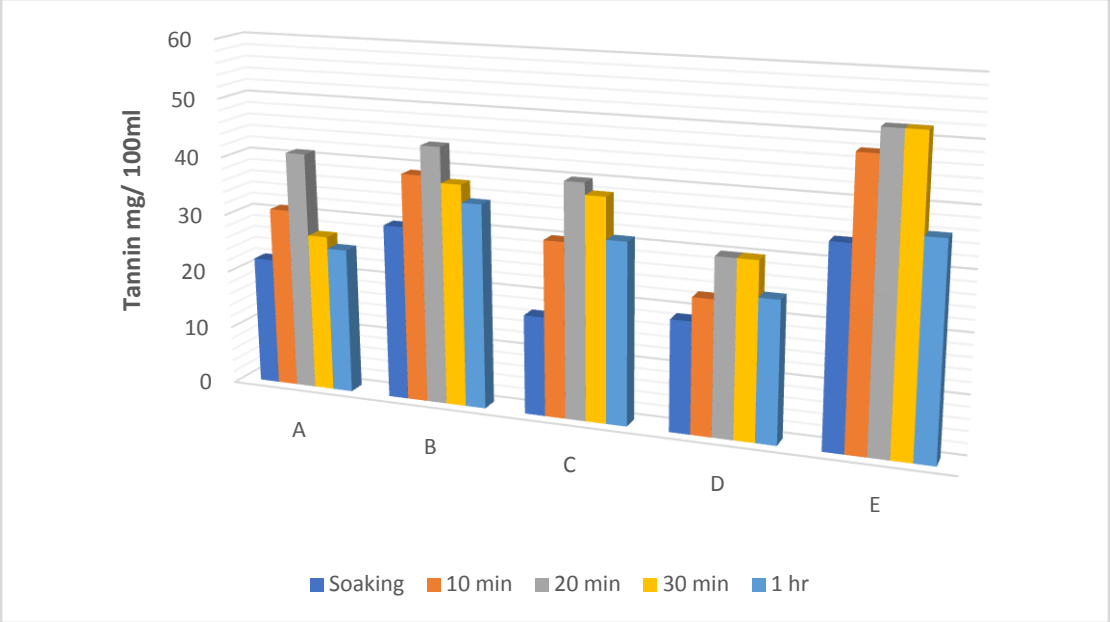


Fig. 11 Green tea samples tannin concentration "mg/100 ml" at different brewing time

The effect of heating time in our chemical analysis there is a difference between the percentage of tannin in the five sample's preparations. The average values of tannin in the soaking samples A, B, C, D and E were 22, 30, 17, 19.25 and 34.44 mg/100ml respectively. While the 10 minutes samples A, B, C, D and E was 31, 39, 30.88, 23.2 and 48 mg/100ml respectively. According to 20-minute samples A, B, C, D and E was 41, 44, 40.21, 30.98 and 52 mg/100ml respectively. Regards of 30-minute samples A, B, C, D and E was 27, 38, 38, 30.1 and 52.37 mg/100ml. 1hr samples A, B, C, D and E was 25, 35, 31, 24.7 and 36.1 Fig (11).

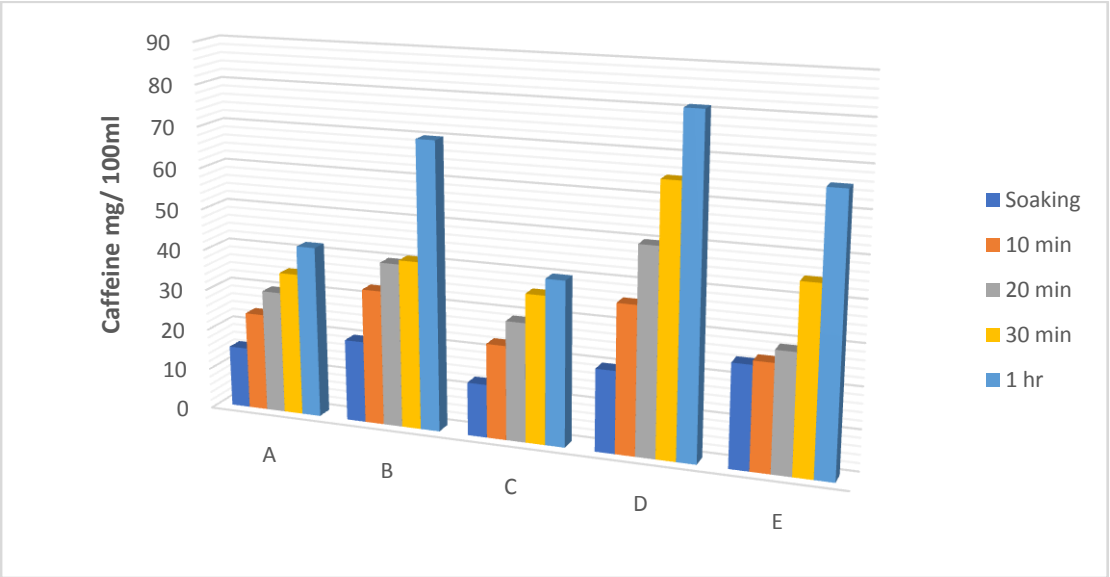


Fig. 12 Green tea samples caffeine concentration "mg/100 ml" at different brewing time

In comparison, there also was a significant difference between the values of caffeine in the five sample's preparations. The average values of caffeine soaking samples A, B, C, D and E was 15, 20, 13, 20.11 and 24.78 mg/100ml. While in samples of 10 minutes A, B, C, D and E was 24, 33, 23, 36 and 25.99. And according to samples preparing 20 minutes A, B, C, D and E was 30, 40, 29, 50 and 28.9. 30-minute samples A, B, C, D and E was 35, 41, 35.8, 65 and 44.5. Otherwise, 1hr samples A, B, C, D and E was 42, 70, 39.5, 81 and 66. In Fig (12)

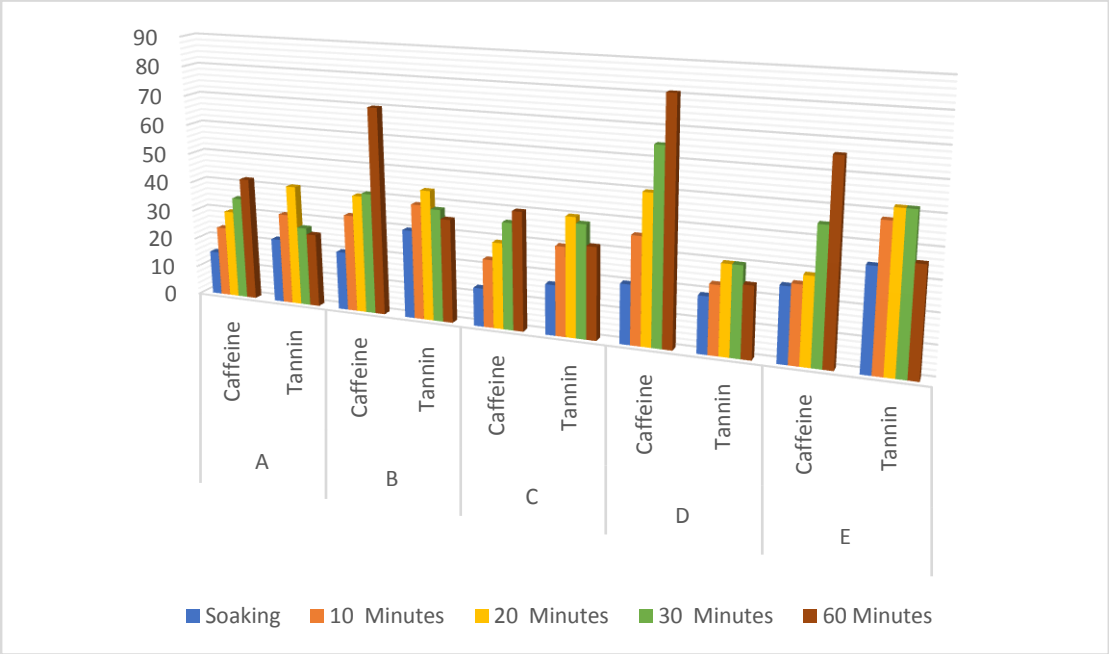


Fig. 13 Comparisons between Green tea samples caffeine and tannin concentration "mg/100 ml" at different brewing time.

4-Discussion:

In fact, the researchers believe that this study is the first in Libya, which included the study of three aspects of a food product (green tea) in one research during the same period and from one product line. The researchers studied the knowledge, habits, and practice of 500 samples about green tea. The technical and laboratory parameters were also studied and then compared all the results with the quality requirements represented in the Libyan standard specification for tea. The results of our study mainly included younger consumers between 18 and 40 years (67%), the participants were mainly women (67%), and most of the sample (71.2%) had a university level of education or higher, which could make the income of the largest percentage was 1000 LYD Libyans and over (44.6%). The majority reported being in good health (56.4%). Like another study done by Vashavi et al in India, which showed that most of the study participants were young adults, 61% were between the ages of 20-40 [(40)]. As shown in Figure (2), most areas of Benghazi were covered to participate in filling out the questionnaire in a step to cover all segments of society with their different customs and tradition. Also, green tea is consumed by the majority of the studied samples 83%, with a consumption rate of 1-2 cups per day reported by most participants 52%, in relatively close to the study of Mohamad and others in Chennai city, which stated that 44% who drink two cups a day [(41)], there was a significant between monthly income and amount green tea by participant (P=0.021), agreed with a study done by Razia in India(2018) on the purchasing behavior of green tea consumers found that highly educated and high-income people are more interested in buying green tea [(42)].

Among the types of green tea consumed by respondents, E green tea was the most predominant, with 34% of green tea drinkers choosing this type. There was a statistically significant difference between

the location and type of green tea (chi-square test p=0.038) probably due to popularity in the local market. Most participants chose brands due to the taste (52%) of the tea. This indicates that taste was the dominant factor in determining brand preferences for most participants, there was a significant difference in young adults cited taste and quality (p=0.008), a significant difference in gender males were more likely to cited quality, while females cited favored teste (p=0.038), this is another reason why taste make the largest percentage in this study. In disagreement to a study has been done by Bandara et al in Sri Lank (2016) concludes that both income and education level significantly influence the choice of green tea brand [43]. The taste of green tea plays a major role in selecting the green tea brand according to 62% of the participants, followed by the manufacturer country, 17%, and price 12%. In interfering with a study by Ewa and others in Poland in 2022 the quality of tea was mentioned as the most important factor by 76.5% of respondents, followed by price (57.1%), and brand (45.9%) [44]. A statically significant difference between socio-demographic younger participants, those from smaller families, and individuals with higher education levels tended to focus primarily on taste when buying green tea.

Meanwhile, older participants, those from larger families and people with less education placed relatively more importance on price, country of origin, and other factors. For judging the quality of green tea most participants were by test (57.9%), there was no static significance, due to everyone being different, and everyone having different flavors. Finally, the taste and aroma need to be personally enjoyably. The most preferred color by the participants was medium green color, with 62% of respondents choosing it. The second most preferred color was a lighter green color, chosen by 23% of respondents. Our study revealed a slight tendency toward consuming tea among children 26.5% reported that their children drink green tea aged 5-15 years similar to the study done by Xiaoli et al (2016), the study analyzed that the green tea beverage consumption for Chinese children and adolescents aged between 6-17 years and found that tea beverages were the top beverage consumed daily18.9% [45]. A study done by Mijong and others (2008) investigated that the consumption of green tea among Japanese preschool children was 27.6% [46]. in contrary to our result, it was 17% less than 5 years. As well as we found statically significant maternal education level (p=0.000) was a factor associated with green tea consumption among preschool children in Libya. Most of the participants reported preferring green tea prepared on the same day with 56%, Additionally, a majority of participants (44.7%) believed that storing tea for a day can lead to a loss of properties such as flavor and benefit.

There were no statically significant interpretations of these, this indicates that most do not consume leftover green tea and bitter test. Our study found that a high rate of 48% of the participants consumed green tea for its antioxidant components of green tea; this indicates limited awareness of its full nutrient profile, with a smaller proportion of participants reporting having background knowledge of side effects associated with green tea, there was statically significant degree between age and knowledge of components and side effect (p= 0.004, p= 0.035 respectively). A higher proportion of younger adults mentioned more awareness than older participants above 40 years were likely to report not knowing. In contrast to a study conducted by Arif Jan and others in Pakistan (2015) highlighted the attitudes of the population regarding the benefits of green tea [47]. Our study found that 43% of the people used green tea for increased metabolic rate, Moreover, the results indicated that green tea is considered an antioxidant, with 20% of the participants agreeing with this statement. Another research done by Mailud El-Amari, and others in Libya discussed the potential health benefits of green tea, the research describes the results of a study on the knowledge of early adulthood about antioxidants, which found that only 50.6% of the participants had knowledge about antioxidants [21].

The Source of information about green tea benefits as indicated by participants was the internet with 45%, meanwhile, 26% of people obtain information about green tea from sources other than the internet (this could include books, magazines, word-of-mouth, etc. in comparison with a study done by Vashavi al et in India showed that TV was (55%) the primary resource of information about the benefits of green tea [40]. This reveals that people depend on the internet in Libya to build their information. there is a significant relationship between age and education level (p=0.001, p=0.034 respectively) interpretation that older adults may be less likely to use the internet due to factors such as lack of access, lack of interest, or lack of knowledge about how to use the internet [48]. Based on a study by Carolny (2010) showed how drinking tea can steep genes in health, typically one would use water that is not quite boiling, and pour it over the tea, letting the leaves steep for approximately 2 to 3 minutes [49]. In contrast to our study most respondents, 38%, preferred to boil their green tea for 10 minutes. 30% of respondents preferred to boil their green tea for 20 minutes.

Our research work found that most participants prefer to drink green tea after lunch (60%), followed by after trabecular (16.5%), after dinner (14%), and in the morning (8.5%). Contrary to a study done by Mohamed Thameemul et al in Chenna City (2020) were 58% in the early morning, followed by 30% during the afternoon [50]. There were statically differences between time preference and socio-demographist factors due to tea consumption being a distinct ritual in Libya, and it is often served after meals. Most participants (66.3%) reported putting green tea together with boiling water, and most participants (53%) reported drinking green tea with sugar. There was a statically difference between putting sugar and green tea (p=0.018) females were more interested to drink green tea without sugar than males.

As we mentioned before this study considered the first Libyan study that cover quality of green tea in a wide aspect. Table (9) showed that Libyan tea specifications require samples to be free of impurities and infected parts. Samples A, B, and E were clean, while samples C and D contained impurities indicating differences in production practices, quality control measures, and leaf sourcing. All samples retained their natural properties, except for samples B and E, which were heterogeneous due to variations in size, shape, or color. Connected with table (10) for the chemical quality of green tea. Based on our analysis we found the humidity in all samples was in the range of Libyan standards (under 8%), supported by the range specified by Egyptian 8 % [51]. The total ash in all samples met Libyan standards (4-7%), except sample c which was lower than it, but this different, but this differs from the findings of Chen, and others In China (2001) who found that the total ash content in 18 different Chinese green tea samples ranged from 9.6% to 22.9%, with an average of 14.8% [52].

Also, these results come close to the results of Vanity et al. (2018) who analyzed green tea from different geographical regions in India. They observed that tea with 44-47% dissolved ash had optimum nutritional value while maintaining good sensory properties [53]. The total ash dissolved in all samples was in the range of Libyan standards (45% minimum). Contrary to the study done by Begum and others in India (2010) measured the levels of specific minerals (potassium, calcium, magnesium, etc.) dissolved into brewed green tea from three varietals. They found that between 31% to 53% of the total ash content was extracted into the tea, depending on the green tea variety [54].

The alkalinity of Ash Dissolved in Water (KOH) in all samples met the Libyan required standards (1-3 %) this agrees with Jiang et al. (2010) who studied four types of Chinese green tea and reported alkalinity values ranging from 849 to 1336 mg KOH/L. (0.8-1.3 %) [55]. The Crude Fiber in all samples was in the acceptable range of Libyan standards (under 16.5 %) contrary to a study by Muramatsu et al. (1986) who found 22.1% crude fiber relative to dry weight in green tea leaves [56]. The Caffeine in all samples was in the accepted range in the Libyan measurement's standards (1.5 % minimum), which corresponds with Kadan et al. (India 2006) who found caffeine concentrations in Indian green tea samples ranging from 2.6% to 3.6% of dry leaf weight [57], also agrees with Muramatsu et al. who reported an average caffeine content of 3.5% in Japanese green tea leaves [56]. Also corresponds with S. O**.** Aroyeun (2011), who revealed the caffeine content ranged from 2.04% to 3.41% [29]. The tannin levels in all samples were in the range of Libyan standards (7-15%) which corresponds with Katiyar et al. in India (2012) who measured tannin levels in Indian green tea samples and reported a range of 7.21% to 11.94% [58]. The stem ratio in all samples was acceptable to Libyan Standards, (10.0 %), this result corresponds with a study by Hakim et al. in Bangladesh (2017) that analyzed silver needle and pekoe-grade green tea leaves; They reported that silver needle leaves had a significantly lower stem ratio of 1:17 compared to 1:10 for pekoe grade [59].

Moreover, the laboratory data of chemical parameters of five samples of green tea that were labeled as (A, B, C, D, E) were mentioned in table (12,13), each sample were undergo to soaking and boiling at different boiling time (10,20,30 minutes up to one hour). The laboratory analysis demonstrated that method of the preparation effect on percentage of caffeine and tannin. The tannin values in the samples mentioned table (12), noticed that the values of tannins increased with the boiling time up to 20min, then decreased with increase duration, except in sample (E) the values of tannin increased with boiling time up to 30min, then decrease at 1hr. Based on study have been done by Wiwik Sulistiyowat (2020), the cause of variation tannin content is the duration of brewing and the amount of dry tea [60].

In the same context Libyan study has been done by Amal Rajab and another (2009) noticed that the concentration caffeine and tannin in green tea increase with increase boiling time and constant of temperature of water at 100C° (5min and 30min) [32]. While different study done in Libya by ZE

Ahmida and another (2021), there the constant of temperature of water at 70C° (5min) (in our study temperature is constant), the result it was found that the imported tea (market) samples contain the least amount of tannin, our result noticed caffeine values in mentioned fig. (12) the maximum caffeine content was found at 1 h of boiling, while as lowest at soaking [37]. The increase in the caffeine content with an increase of boiling time was observed for all the tea samples, based on study turkey done Sena Saklar and another (2015), the cause caffeine is a very stable molecule easily soluble in hot water and maintained in the tea infusion, but different from our result in temperature water and different in boiling time, they found the optimal brewing conditions the caffienin at 85C° for 3min [61]. Contrary to study done by David Labbe and another in Canada (2005) there is an argument between temperature and time (in our study, temperature is constant, time is variable), noticed all the time/temperature dependent compounds, caffeine is an important compound in tea the best extraction conditions were determined at 70-80C° during brewing duration of 20-40 min [62].

5- CONCLUSION:

Based on the results of this study, most subjects found that they consumed green tea significantly. The highest percent reported for green tea consumption in most participants is (1-2) cups per day after lunch. The study also found a relationship between the number of times to drink green tea and income. However, about participle selected type of green tea small percentage because of the price while the majority high because of the taste and quality. There is a high level from children don't drink green tea while half of the participants know the benefits of green tea for children. We found an association between believing tea is good for children and education level. A high percentage knows the antioxidant nutrients of green tea and knows the increase in metabolic rate whereas a high percentage does not know about the side effects of green tea. Based on the information, the analysis found that the 5 green tea samples (A, B, C, D, and E) can be considered acceptable according to the analysis based on the relevant Libyan quality standards for green tea in terms of key parameters like moisture content, total ash, alkalinity of ash, crude fiber, caffeine, tannins, and stem ratio. However, there were some variances in terms of sample cleanliness and leaf appearance. While samples A, B, and E were found to be clean and free of impurities, samples C and D contained impurities. Similarly, while most samples had a homogeneous leaf appearance, samples B and E were heterogeneous. Tannin when consumed reduced the digestibility of nutrients. However, most types of samples under study high concentration of tannin during the 20 minutes brewing time while lower concentrations level of tannin in soaking so it's best way for prepared green tea. For caffeine content, we observed an increase in concentration during the one-hour brewing time, while lower concentrations during soaking.

Ethical Approval and Consent:

The ethical clearance for the present study was obtained from the University of Benghazi, Faculty of Public Health, Nutrition Department. The consent from each study subject was taken directly from them after explaining the nature of the study.

6- RECOMMENDATIONS:

Tea consumption should be at recommended level to avoid health problems. Encourage the preparation of green tea for appropriate use and make people aware of the benefits of using green tea appropriately. manufacturers and sellers should implement quality control measures to improve the quality of their products. This could include conducting regular testing for impurities and infected parts and ensuring that the tea leaves are sourced from high-quality suppliers store green tea in room temperature place to minimize moisture content and maintain freshness.

7- FUTURE DIRECTIONS:

Extensive study of other commercial types such as flavored tea and tea bags. Extend research study for the benefits of green tea for children and increase awareness for parents because of half of participants in our study don't know it. Analysis of more parameters to fully assess green tea quality according to Libyan standards with large sample size.

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Table 12. Shows the Tannin Content of the Five Samples Under Study at Different Brewing Times.

Sample	A	B	C	D	E
	Tannin mg/100ml	**Tannin** mg/100ml	**Tannin** mg/100ml	**Tannin** mg/100ml	**Tannin** mg/100ml
Soaking	22	30	17	19.25	34.44
10 min	31	39	30.88	23.2	48
20 min	41	44	40.21	30.98	52
30 min	27	38	38	30.1	52.37
1 hr	25	35	31	24.7	36.1

Table 13. Shows the Caffeine Content of the Five Samples Under Study at Different Brewing Times.

Sample	A	B	C	D	E
	Caffeine mg/100ml	**Caffeine** mg/100ml	**Caffeine** mg/100ml	**Caffeine** mg/100ml	**Caffeine** mg/100ml
Soaking	15	20	13	20.11	24.78
10 min	24	33	23	36	25.99
20 min	30	40	29	50	28.9

30 min	35	41	35.8	65	44.5
1 hr	42	70	39.5	81	66