

## **Comparing Saudi Honey with Honey in the Saudi Market - A Statistical Study**

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### **Abstract:**

The research presented a number of descriptive statistics related to honey in the Saudi market, whether local or imported, and it aimed to study the quality of Saudi honey and its competitive advantages compared to imported honey. A number of statistical methods were used to analyze the results of the sample in the Saudi market, and concluded important results, including the following, there are statistically significant differences for the average HMF in the honey sample from the Kingdom of Saudi Arabia and other countries, as the value of the statistical significance is (0.02) which is less than the level of morality (0.00), so there are differences between the two averages in favor of the average of other countries (60.16) compared to the Kingdom of Saudi Arabia With an average of (31.58), and there are statistically significant differences for the average acidity in the honey sample from the Kingdom of Saudi Arabia and other countries, as the value of the statistical significance is (0.00) which is less than the level of morality (0.00), so there are differences

between the two averages in favor of the average of the Kingdom of Saudi Arabia (30.91) compared to other countries Average (17.19)

## **Introduction**

The Kingdom has made great efforts at the local, regional and global levels in developing the beekeeping sector, honey production and the beekeeping profession. It is worth mentioning that the Kingdom produces more than 5,000 tons of honey annually, and the number of beehives exceeds one million denominations throughout the Kingdom, and the Kingdom annually imports approximately 25,000 tons of honey, while the annual average of Riyadh imports during the last three years is about 1.3 million parcels at a cost of 130 million riyals (\$34.6 million), used by beekeepers to produce honey for one time. The Ministry of Environment, Water and Agriculture also launched a package of programs to develop the honey industry and production sector Bees since 2018, where honey contributes about 660 million riyals (\$176 million), representing 1.07 percent of the country's agricultural GDP." At a time, 6 programs were identified to support the industry represented in improving and developing the local honey bee breed and developing infrastructure, Raising and developing the efficiency of local content and capacity building, regulating and developing bee pastures and encouraging investment and scientific research.

Honey is one of the important foodstuffs for humans and common in societies due to the benefits that honey contains and provides to humans, and among the most prominent beneficial benefits provided by honey are carbohydrates that include fructose sugars, glucose and sucrose by 85% -95% as a total sum of carbohydrates, and honey includes other substances such as water and a small percentage of acid Formic, in addition to small amounts of other acids, proteins, vitamins, enzymes, minerals, pollen, fungi, algae, yeasts, and other solid materials such as wax.(Kalaf,M.M. 2002)

Honey has been known to peoples since ancient times, where the sanctity of honey was demonstrated for Muslims, as the importance of honey was mentioned in the Holy Qur'an, and it was mentioned in Surat An-Nahl, and God Almighty described it as a healing for people. In three: in the condition of cupping or drinking honey or cauterization with fire, and forbid my nation from cauterization, ford in the Qur'an on the tongue of the Messenger that he proved science and hadith, and it was noted through the results of the analysis of the components of honey, as it resists bacteria and an antidote to them, and perhaps one day will replace antibiotics.(Alhumiari,A. 2001)

## **First: the specifications of natural honey**

Honey's antibacterial effect comes from the fact that honey is natural and the sugar content in it determines whether it is natural or synthetic. Its Saudi standard specifications for bee honey stipulate that natural honey must contain at least 43% glucose, 34% fructose and 8% sucrose, according to Saudi and Gulf standards. For sucrose, its proportion should be no more than 16% for various types of honey, and no more than 14% for lavender honey - borage (borago or vicinalis).

The food sources of the honey bee are diverse and according to the nature of their abundance in the environment in which the bee lives. These sources include pollen, which workers

called pollen foragers collect and store in the hexagonal wax eyes, unlike workers who collect nectar.

And between Catherine and Dave (2001) that honey bees do not visit flowers that have previously been visited by other bees, but return after 24 hours to prefer these flowers over other flowers, and bees can make up for any shortage of pollen or stored in the honeybee colony Rotjan and his group. (2002) by augmenting the pollen-collecting mechanism.

Other important sources of nectar are the juices of ripe fruits such as grapes, arrowroot, aloe, courgette, apricots, and some dates. These materials are rich in bean sucrose (1989). Another important source for bees, through which they obtain nectar, is honeydew, a sweet-tasting liquid secreted by similar-winged insects (Homoptera), especially aphids and the twenty insects feeding on plants (1993-White), which constitute another source of food for bees when plant nectar sources are scarce.(Anklam,E. 1998)

The importance of honey has been known for thousands of years, as it contains food, healing and longevity, and it is food for children, youth and adults, and despite its ancient discovery and use and the progress and development reached by humanity today, honey is still the subject of human interest and admiration for its characteristics as research has proven Modern scientific studies show that the types of honey not only differ in color, smell and taste, but also differ in chemical and therapeutic properties, and the different qualities of honey depend to a large extent on the plants from which honey is collected, as well as on the soil in which these plants grow.

Honey of bees is a sweet, dense liquid, viscous, that differs in its natural characteristics (colour, odor, flavor, density, moisture, and ability to crystallize), and in its chemical composition, according to the flowers from which nectar and pollen are derived, the type of worker that collected all that, and the time of its collection.

### **Second: Saudi honey specifications**

Saudi honey is a distinctive honey that is accepted by many of the people of the Kingdom and is widely used as a medicine and also as food. Saudi honey is characterized by high quality and great fame for its purity due to the presence of natural pastures that God loved for the Kingdom. The pasture and the quality of flowers and plants that bees feed on.

The Kingdom produces more than 5,000 tons of honey annually, and the number of beehives exceeds one million sects throughout the Kingdom. The most famous types of honey in the Kingdom of Saudi Arabia are Sidr honey, acacia honey (talha, Samar, Dahyan), and clover honey, and harvested honey. Produced locally on advanced positions in global forums.

Chemical or biochemical treatment is not used on the crystallization of honey to influence, nor is it allowed to modify the natural acidity of the honey, in addition, it does not affect the basic composition of honey or its treatment to the extent that it changes and may not heat its quality and / or inhibit the activity of naturally present enzymes or reduce their activity The moisture content should not exceed 23% for heather honey and 20% for honey of other species, in addition to that the free acidity does not exceed 50 milligrams equiv/1000 grams (excluding acacia honey such as

Samar, Sidr, acacia and fork ... etc., from the estimation of the value of free acidity, So that it does not exceed 100 milligrams equivalent per 1000 grams.

The activity of the diastase enzyme is also not less than that of Goth units, and of Goth units in the case of honey types in which the enzyme is naturally reduced, that the content of hydroxyl methyl furfural in honey does not exceed the length of its validity after treatment and/or blending to 40 in the case of honey that is the country of Its origin is from countries or mg/kg, but in the regions it is characterized by gradients in the case of high temperatures, as well as for the mixture of this type of honey, the content of hydroxyl methyl furfural should not exceed 80 mg/kg.

### **Third: The amount of production of honey in Saudi Arabia and the amount of import**

To maximize the economic return of honey, as the country's institutions continue to support the industry, in light of the continuous growth of the number of beekeepers who practice modern methods of honey production, and the ability to increase the number of highly qualified specialists in this field. The ministry confirmed to Asharq Al-Awsat that Saudi Arabia annually imports approximately 25,000 tons of honey, while its production is estimated at 2,646 tons of honey, while the annual average of Riyadh imports during the past three years is about 1.3 million packages at a cost of 130 million riyals (34.6 million riyals). dollars), used by beekeepers to produce one-time honey. The state launched a package of programs to develop the bee honey industry and production sector in 2018, and said that "honey contributes about 660 million riyals (\$176 million), representing 1.07 percent of the country's agricultural gross domestic product," at a time when it identified 6 programs to support the industry, represented by In improving and developing the local honey bee breed and developing infrastructure.

### **Research Objective:**

This research aims to conduct a statistical analysis of different samples of Saudi honey and compare it with honey imported in the Saudi market, and extracting a number of important statistical variables that lead to drawing conclusions and making important recommendations.

The purpose of this research is to present the assumptions underlying this research, as well as to provide the research strategy and practical techniques applied, the research sets the current research traditions in the honey production, the tool used in the study, the method of preparation, how to build and develop, and describes the researcher's procedures in designing and coding the search tool, as well as the tools to collect data In addition.

### **Research Questions:**

The research aims to get results and answers for the following questions:

What is the productivity of local Saudi honey?

What is the competitive advantage in local Saudi honey over imported honey?

What is the quality of Saudi honey compared to imported honey?

**Research Method:**

The researcher used the descriptive analytical method to achieve its research objectives, which depend on the study of the phenomenon as it is in fact and is concerned and accurate description and expressed in qualitative and quantitative expression, not only this method of collecting information about this phenomenon in order to investigate its manifestations and its different relations, Analysis, interpretation and access to conclusions based on the proposed scenario so as to increase the balance of knowledge in this study.

**The researcher used two main sources of information:**

Secondary sources:

Where the researcher directed the theoretical framework of the research to the secondary data sources, and related books and references, periodicals, articles and reports, as well as previous studies, and reading in various sites on the Internet.

Primary sources:

To achieve the analytical aspects of the research topic, the researcher sought to collect primary data through a sample of 479 of honey in the local market.

**Statistical methods are used**

The researcher in conducting statistical analyzes on the Statistical Package for the hypotheses as to rely on the following statistical methods program :-( SPSS) win, which depends on the following statistical methods

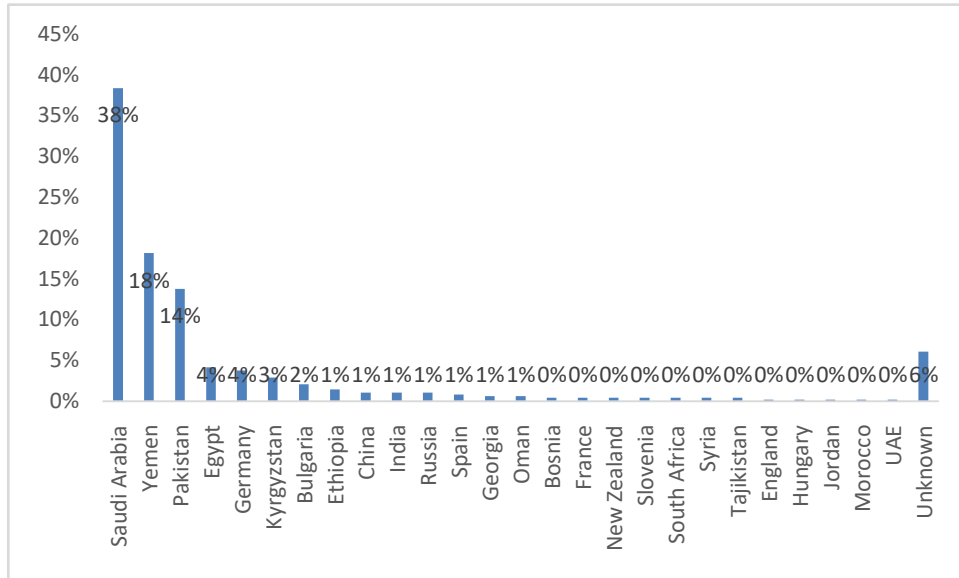
1. Frequencies and percentages
2. Mean, Standard deviation (STD)
3. Graphs
4. Independent sample T-test

**Materials and Method****1. Honey sample**

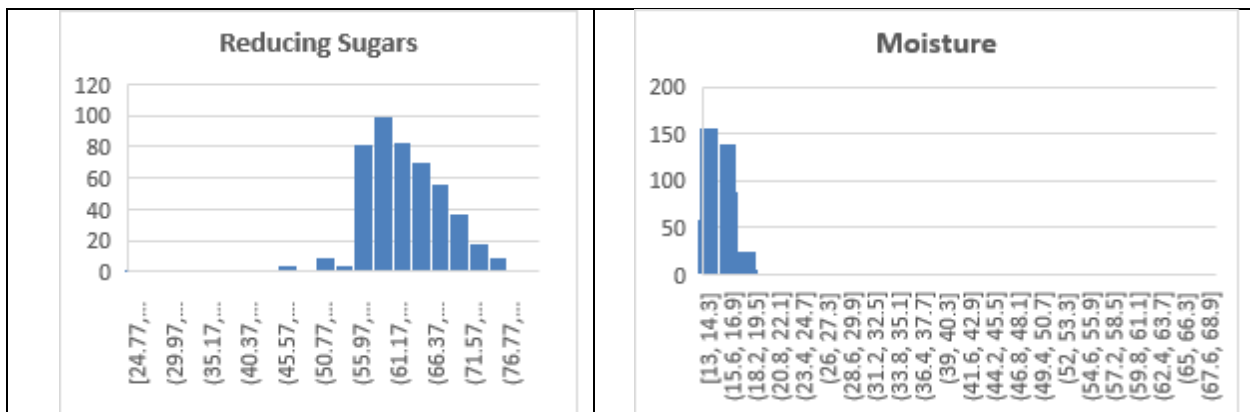
In the study methodology, the researcher used the descriptive approach so that the accurate presentation of the qualitative and quantitative expression of the information, and the investigation and analysis of different relationships, the researcher relied on the method of collecting information for two main sources, namely (the first source) a secondary source in which secondary data related to books, references and reports were collected. And (the second source) is the primary sources in which the analytical aspects were collected and in which the researcher sought to collect primary data by collecting the sample 479 of honey in the local market, and relied on the use of statistical methods by conducting statistical analyzes on the statistical package for hypotheses based on the

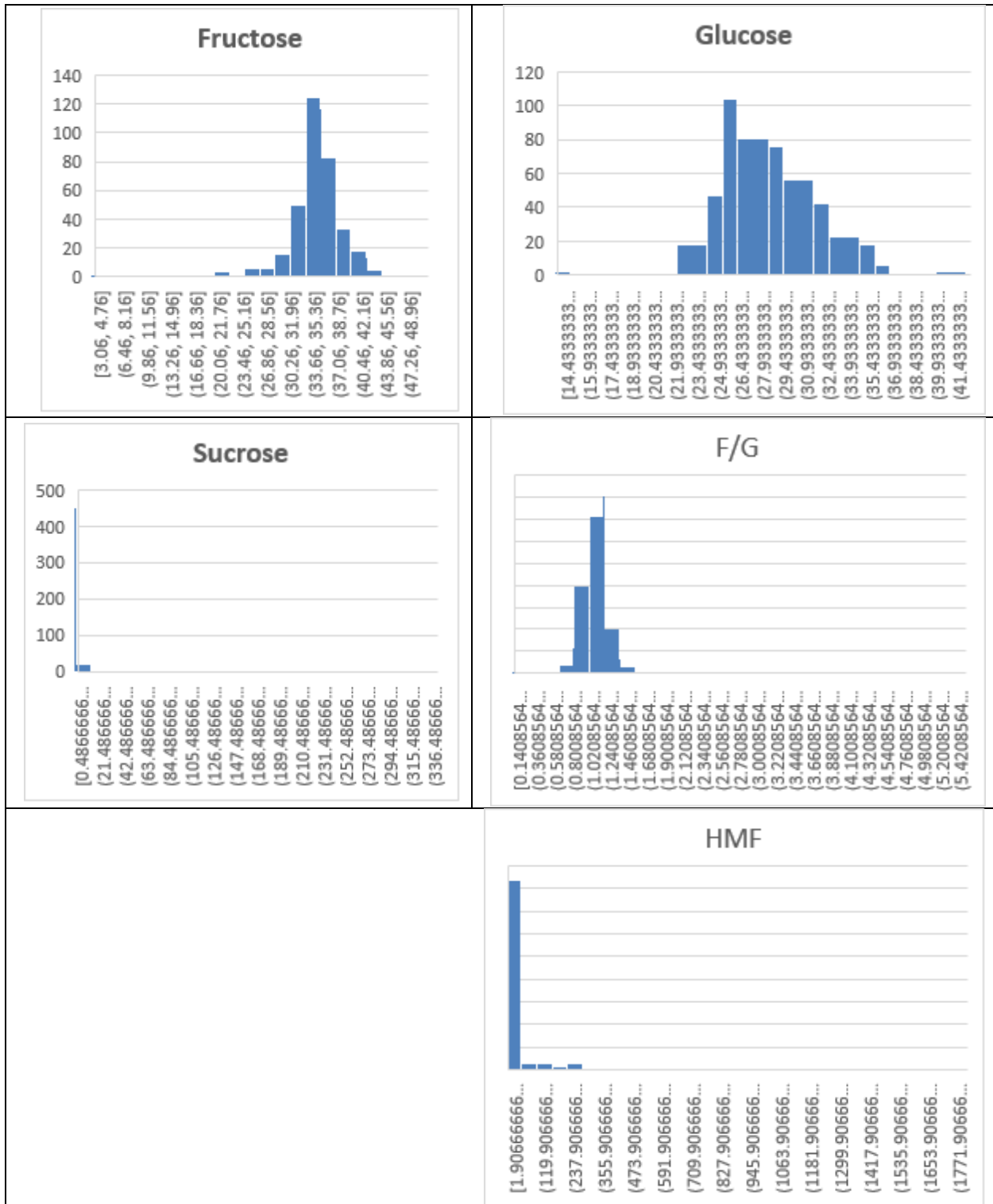
program Statistical methods (SPSS), in which "frequencies, percentages, standard deviation (STD), graphs, and an independent sample T-test have been explained.

The researcher relied in his study on the comparison between the honey of the Kingdom of Saudi Arabia and included in his comparison the honey of Yemen, Egypt, Pakistan, Germany, Bulgaria, Kyrgyzstan and the Sultanate of Oman, which is clear from the following graphic distribution



Moisture rate was detected by the refractometer through the irrigation facts scale, which proved mean moisture content = 16.1 and STDV = 2.8, and using HPLC to inverted sugars, which appeared with an average percentage = 65.3 and STDV 5.8, glucose = 29.5 and STDV 3.4, and fructose mean 35.8 and 3.7 standard , F/G means 1.2 and STDV 0.2, sucrose means 3.2 and 15.7 std, HMF means 49.2 and STDV 131.4, IHC is detected by titration, Acidity means 22.5 and 20.2 standard, which showed the same results with graphical distributions.





1. Chemical analysis

Devices and methods of examination:

Analysis	equipment	Standard (Examination and Test Methods)
Moisture	Refractometer	- Gulf Standard 122/1990 - Saudi Standard Specification

		102/1990
Acidity	Titration method	- Gulf Standard 122/1990 - Saudi Standard Specification 102/1990
Hydroxymethylfurfural (HMF) .	Spectrophotometer	- Gulf Standard 122/1990 - Saudi Standard Specification 102/1990
<b>Sugars :</b> - glucose - fructose - sucrose	HPLC chromatograph	<b>According to the specification AOAC Official Method 977.20</b>

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5. Frequencies and percentages
6. Mean, Standard deviation (STD)
7. Graphs
8. Independent sample T-test

#### **The Statistical results**

**Table (1) the frequencies**

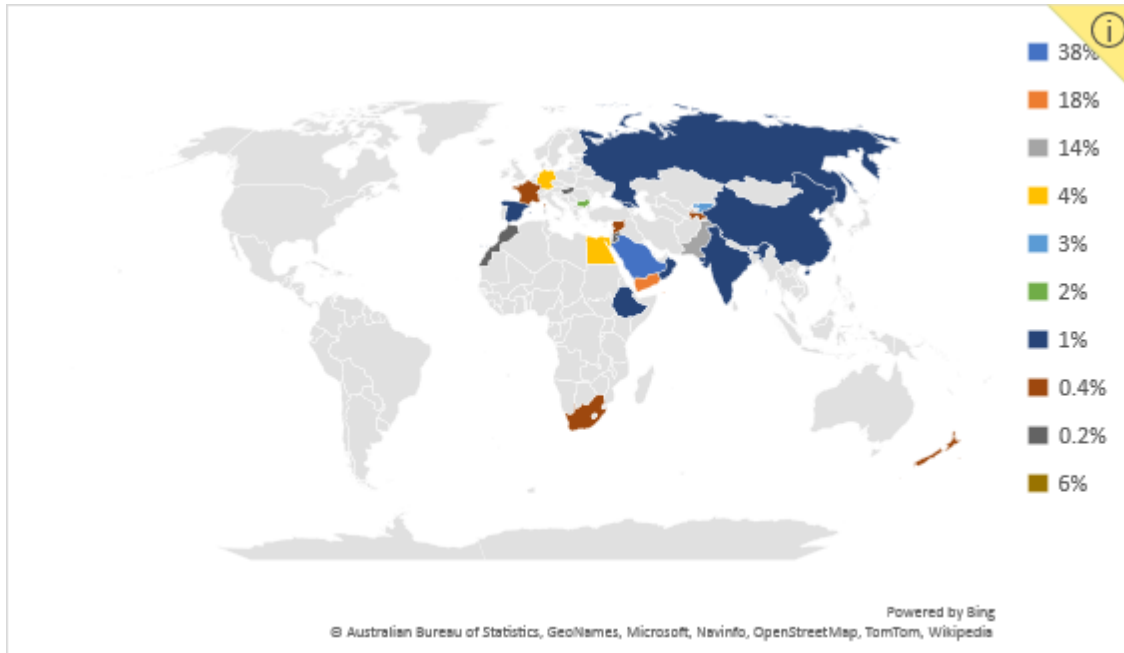
	<b>Frequency</b>	<b>Percent</b>
<b>Saudi Arabia</b>	<b>184</b>	<b>38%</b>
<b>Yemen</b>	<b>87</b>	<b>18%</b>
<b>Pakistan</b>	<b>66</b>	<b>14%</b>



<b>Egypt</b>	<b>20</b>	<b>4%</b>
<b>Germany</b>	<b>18</b>	<b>4%</b>
<b>Kyrgyzstan</b>	<b>14</b>	<b>3%</b>
<b>Bulgaria</b>	<b>10</b>	<b>2%</b>
<b>Ethiopia</b>	<b>7</b>	<b>1%</b>
<b>China</b>	<b>5</b>	<b>1%</b>
<b>India</b>	<b>5</b>	<b>1%</b>
<b>Russia</b>	<b>5</b>	<b>1%</b>
<b>Spain</b>	<b>4</b>	<b>1%</b>
<b>Georgia</b>	<b>3</b>	<b>1%</b>
<b>Oman</b>	<b>3</b>	<b>1%</b>
<b>Bosnia</b>	<b>2</b>	<b>0%</b>
<b>France</b>	<b>2</b>	<b>0%</b>
<b>New Zealand</b>	<b>2</b>	<b>0%</b>
<b>Slovenia</b>	<b>2</b>	<b>0%</b>
<b>South Africa</b>	<b>2</b>	<b>0%</b>
<b>Syria</b>	<b>2</b>	<b>0%</b>
<b>Tajikistan</b>	<b>2</b>	<b>0%</b>
<b>England</b>	<b>1</b>	<b>0%</b>
<b>Hungary</b>	<b>1</b>	<b>0%</b>
<b>Jordan</b>	<b>1</b>	<b>0%</b>
<b>Morocco</b>	<b>1</b>	<b>0%</b>
<b>UAE</b>	<b>1</b>	<b>0%</b>
<b>Unknown</b>	<b>29</b>	<b>6%</b>
<b>Total</b>	<b>479</b>	<b>100.0</b>

**Table shows that**

%38 of the sample are from Saudi Arabia.%18 of the sample are from Yemen. %14 of the sample are from Pakistan.%4 of the sample are from Egypt and Germany. %3 of the sample are from Kyrgyzstan.%2 of the sample are from Bulgaria.%1 of the sample are from Ethiopia ,China, India, Russia, Spain, Georgia, and Oman. and%6 of the sample from unknown places. And the following graphs show the same results:



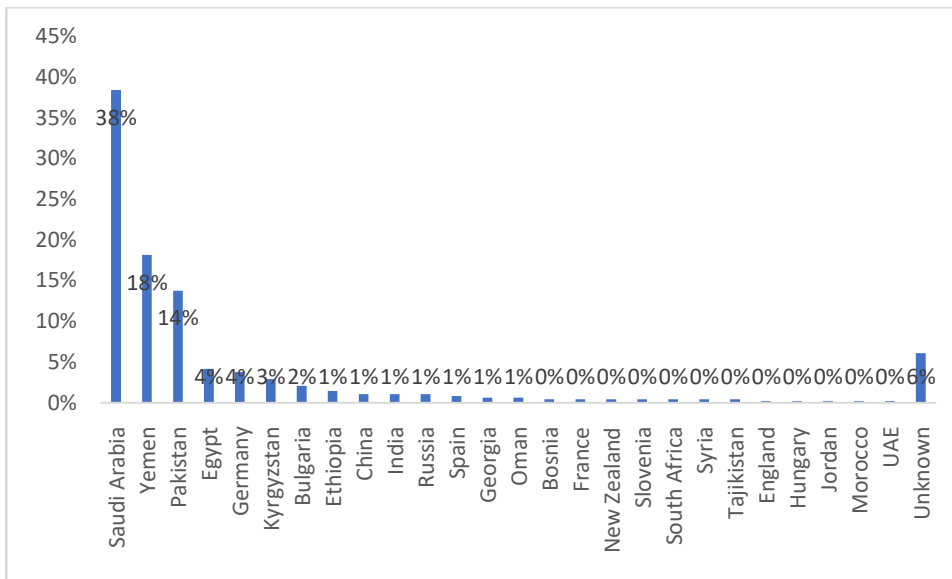


Table (2) Descriptive statistics

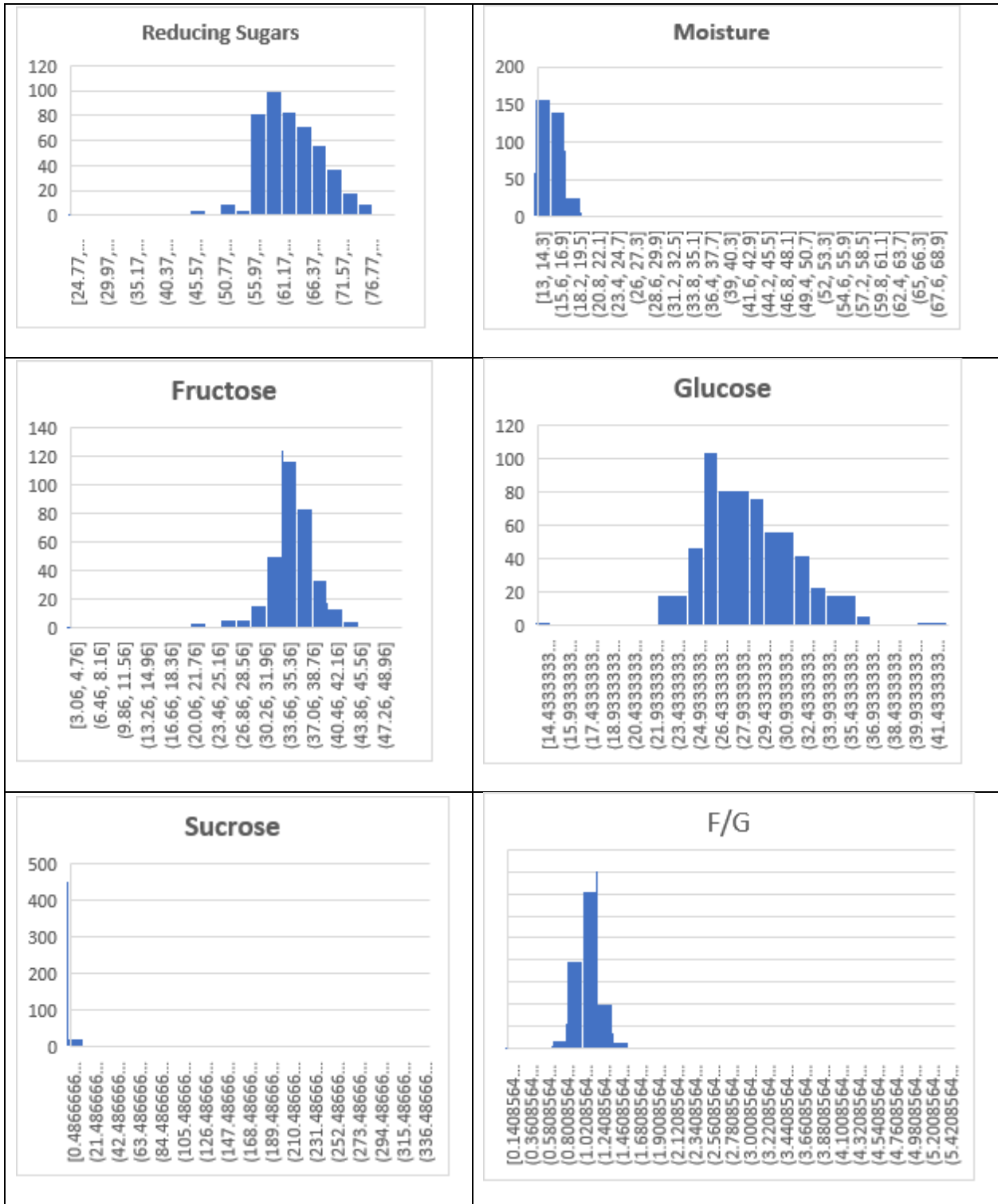
	Moisture	Reducing Sugars	Glucose	Fructose	F/G	Sucrose	HMF	Acidity
<b>Mean</b>	<b>16.1</b>	<b>65.3</b>	<b>29.5</b>	<b>35.8</b>	<b>1.2</b>	<b>3.2</b>	<b>49.2</b>	<b>22.5</b>
<b>Median</b>	<b>15.8</b>	<b>64.8</b>	<b>29.0</b>	<b>35.8</b>	<b>1.2</b>	<b>1.3</b>	<b>17.3</b>	<b>15.3</b>
<b>Std. Deviation</b>	<b>2.8</b>	<b>5.8</b>	<b>3.4</b>	<b>3.7</b>	<b>0.2</b>	<b>15.7</b>	<b>131.4</b>	<b>20.2</b>
<b>Variance</b>	<b>7.9</b>	<b>34.2</b>	<b>11.5</b>	<b>13.7</b>	<b>0.1</b>	<b>245.9</b>	<b>17,278.0</b>	<b>409.6</b>
<b>Range</b>	<b>55.1</b>	<b>55.0</b>	<b>28.0</b>	<b>46.2</b>	<b>5.3</b>	<b>337.6</b>	<b>1,826.1</b>	<b>116.6</b>
<b>Minimum</b>	<b>13.0</b>	<b>24.8</b>	<b>14.4</b>	<b>3.1</b>	<b>0.1</b>	<b>0.5</b>	<b>1.9</b>	<b>4.1</b>
<b>Maximum</b>	<b>68.1</b>	<b>79.8</b>	<b>42.5</b>	<b>49.3</b>	<b>5.4</b>	<b>338.0</b>	<b>1,828.0</b>	<b>120.7</b>

The table shows that

- Humidity has mean =16.1 and STDV=2.8.
- Reducing Sugars has mean=65.3 and STDV 5.8.
- Glucose has mean=29.5 and STDV 3.4.
- Fructose has mean 35.8 and stdv 3.7.
- F/G has mean 1.2 and stdv 0.2.
- Sucrose has mean 3.2 and stdv 15.7.

- HMF has mean 49.2 and stdv 131.4.
- Acidity has mean 22.5 and stdv 20.2 and following graphs show the same results

The distribution of the variables



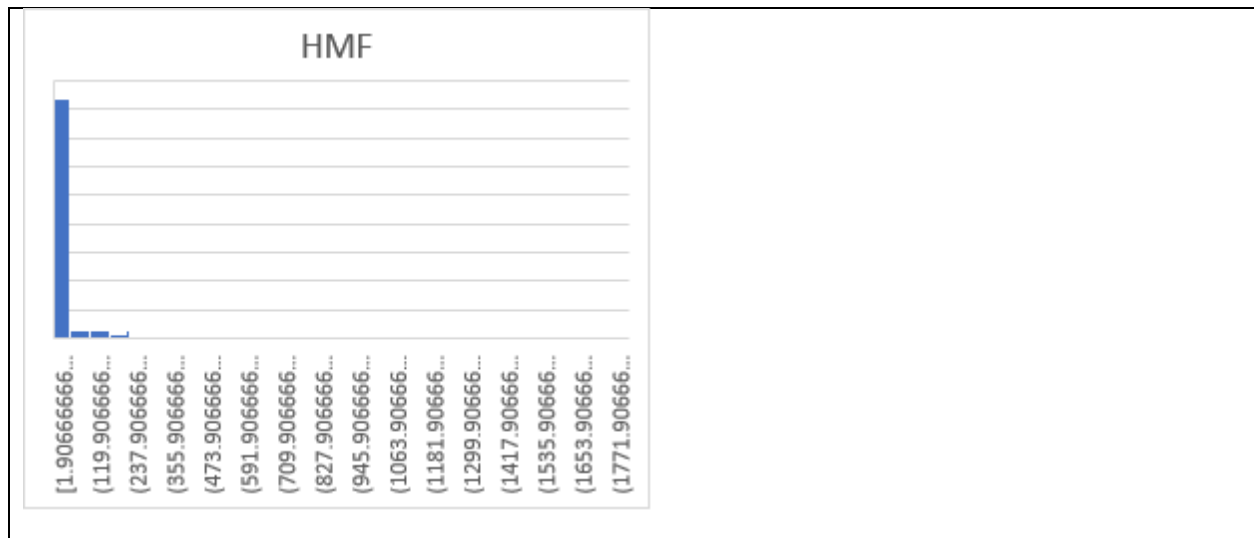


Table (3) T-test

Country		N	Mean	Std. Deviation	Std. Error Mean	T	DF	P.VALUE
Moisture	Saudi Arabia	184	16.14	4.06	0.30	0.16	477	0.873
	Other countries	295	16.09	1.63	0.09			
Reducing Sugars	Saudi Arabia	184	65.02	5.26	0.39	-0.91	477	0.365
	Other countries	295	65.52	6.19	0.36			
Glucose	Saudi Arabia	184	29.24	2.98	0.22	-1.51	477	0.133
	Other countries	295	29.72	3.61	0.21			
Fructose	Saudi Arabia	184	35.78	3.23	0.24	-0.06	477	0.953
	Other countries	295	35.80	3.97	0.23			
F/G	Saudi Arabia	184	1.23	0.12	0.01	0.04	477	0.969
	Other	295	1.23	0.30	0.02			

	countries							
<b>Sucrose</b>	<b>Saudi Arabia</b>	<b>184</b>	<b>2.68</b>	<b>3.00</b>	<b>0.22</b>	<b>- 0.60</b>	<b>477</b>	<b>0.043</b>
	<b>Other countries</b>	<b>295</b>	<b>3.56</b>	<b>19.85</b>	<b>1.16</b>			
<b>HMF</b>	<b>Saudi Arabia</b>	<b>184</b>	<b>31.58</b>	<b>55.97</b>	<b>4.13</b>	<b>- 2.32</b>	<b>477</b>	<b>0.021</b>
	<b>Other countries</b>	<b>295</b>	<b>60.16</b>	<b>160.71</b>	<b>9.36</b>			
<b>Acidity</b>	<b>Saudi Arabia</b>	<b>184</b>	<b>30.91</b>	<b>28.64</b>	<b>2.11</b>	<b>7.64</b>	<b>477</b>	<b>0.000</b>
	<b>Other countries</b>	<b>295</b>	<b>17.19</b>	<b>9.09</b>	<b>0.53</b>			

**It is evident from the results of the table that:**

There are no statistically significant differences for the average humidity in the honey sample from the Kingdom of Saudi Arabia and other countries, as the value of the statistical significance is (0.87) which is greater than the level of significance (0.00), so there are no differences between the two averages.

There are no statistically significant differences for the average reducing sugars in the honey sample from the Kingdom of Saudi Arabia and other countries, as the value of the statistical significance is (0.36), which is greater than the level of morality (0.00), so there are no differences between the two averages.

There are no statistically significant differences for the average glucose in the honey sample from the Kingdom of Saudi Arabia and other countries, as the statistical significance value equals (0.13) which is greater than the level of significance (0.00), so there are no differences between the two averages.

There are no statistically significant differences for the average fructose in the honey sample from the Kingdom of Saudi Arabia and other countries, as the statistical significance value equals (0.95), which is greater than the level of significance (0.00), so there are no differences between the two averages.

There are no statistically significant differences for the mean F/G in the honey sample from the Kingdom of Saudi Arabia and other countries, as the statistical significance value equals (0.97), which is greater than the level of significance (0.00), so there are no differences between the two averages.

There are statistically significant differences for the average of sucrose in the honey sample from the Kingdom of Saudi Arabia and other countries, as the value of the statistical significance is (0.04), which is less than the level of morality (0.00), so there are differences between the two averages in favor of the average of other countries (3.56) compared to the Kingdom of Saudi Arabia. With an average of (2.68).

There are statistically significant differences for the average HMF in the honey sample from the Kingdom of Saudi Arabia and other countries, as the value of the statistical significance is (0.02) which is less than the level of morality (0.00), so there are differences between the two averages in favor of the average of other countries (60.16) compared to the Kingdom of Saudi Arabia With an average of (31.58).

There are statistically significant differences for the average acidity in the honey sample from the Kingdom of Saudi Arabia and other countries, as the value of the statistical significance is (0.00) which is less than the level of morality (0.00), so there are differences between the two averages in favor of the average of the Kingdom of Saudi Arabia (30.91) compared to other countries Average ((17.19

#### **Limitations of results according to the specification:**

Standardization Organization for the Cooperation Council for the Arab States of the Gulf: GSO 147/2008

- 1- As for the acidity test: in the Kingdom honey, black acacia (talh and Samr): always exceeds the standards limits, and this is due to the type of the floral source, and the specification limit has been modified in the new standard of the Food and Drug General Authority No.: SFDA.FD147:2021
- 2- The researcher focused on the comparison of sugars and HMF between Saudi honey and honey in the Saudi market, because sugars are cheated by adding factory glucose, corn syrup, or sugar solutions to bees, and HMF is a compound created as a result of poor storage or exposure of honey to heat, so honey turns from a product Beneficial for a harmful product besides that heat breaks down the enzymes in honey, the most famous of which is the diastase enzyme. (There is a lot of research on this topic.)

#### **Limitations of results according to the specification:**

Standardization Organization for the Cooperation Council for the Arab States of the Gulf: GSO 147/2008

#### **Discussion**

The study presented the laboratory system, which was followed by highlighting the advantages of Saudi honey compared to honey samples from other countries, including (Yemen, Egypt, Pakistan, Oman Authority, India, Germany, Bulgaria, Ethiopia, China, India, Russia, Spain and Georgia, to conduct laboratory tests for each of the samples). obtained, highlighting the differences and physical and chemical properties of each sample separately, and there were many statistical

methods for analyzing the results of the sample in the market. Moisture Inverted sugars (glucose, fructose), F / G, sucrose, HMF and acidity were analyzed, and it was found through the study to be detected Saudi honey is mainly composed of a number of sugars, especially fructose, glucose, a small percentage of sucrose and other sugars. It also contains other substances such as organic acids, enzymes, and solid particles resulting from honey extraction. The proportion of sugars in Saudi honey is estimated from the ratio of glucose and fructose content in Saudi honey by Not less than 60g/100g.

We can say that the exposure of honey to heat affects the chemical, natural or biological properties according to the type of honey, which depends on the basic factors that are based on the plant source, geographical location and climate, and the results are within the limits of the Saudi standard specifications for natural bee honey.

In addition, the viscosity and specific weight of honey samples are inversely proportional to the moisture content if its value increases with a decrease in moisture content and vice versa, and the percentages of minerals in the samples under study vary according to the type of sample, and the honey bee showed a significant inhibitory effect according to all the concentrations used, which confirms that the honey bees It leads to a significant and effective inhibition of the growth of some microbes, whether through the osmotic action (high concentrations), and we conclude that the normal heat treatment and microwave (pasteurization) led to an increase of hydroxymethylfurfural (H.M.F) in honey and the percentage increases with temperature and time, and the increase was A note when heating at a temperature of 100 °C, and if the honey is high in PH such as Sidr honey Aseer (PH 6.06) after heating to a temperature of 100 °C, it does not form hydroxymethylfurfural due to the lack of an important acidity element to be formed, in addition to that heating reduces the Diastase enzyme activity. Heating at 71 m/10, 20 minutes led to a decrease in activity of 26.4% and 49.6%, respectively.

\* **Note:**All tests in this research were done inside the **honey quality laboratory** in Saudi Arabia/Riyadh.

### Recommendations

- The researcher recommends the necessity of expanding the examinations and examinations of honey in the Kingdom of Saudi Arabia, and extending the study to something deeper and broader.
- The researcher recommends more research and studies that educate individuals in the community about how to benefit from honey according to a medical laboratory perspective, and the ability to differentiate between natural and adulterated honey in a simple way.

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