EVALUATION OF PHYSIOCHEMICAL PROPERTIES OF LOCAL APPLE IN KURDISTANS REGION.

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Abstract

Apple is an important fruit desired for taste and nutritive value. The aim of this study was to investigate the comparative analysis between six local apple fruit samples (A: red Irani, B: France, C: yellow Irani, D: Staric, E: red Lebanon and F: yellow Lebanon), (A-C) taken from Haje Omran in (Erbil) and (D-F) samples from Barwari Bala in (Duhok) and to determine the physiochemical properties such as moisture content, ash content, pH, total soluble solids, total titratable acidity, crude protein and crude fiber. From the results of this study, it was found that the moisture content of apple samples D and F which were from Barwari Bala (Dohuk) is higher D with 89.746% and F with 89.066%, this causes that to become these apple samples more softness and delicious taste than Haje Omran (Erbil) samples, whereas ash content of (Duhok) samples especially E with 1.976% and F with 1.950% has lowers content, only sample C mostly of minimum amount than all other samples with 1.883%. However, sample E showed minimum value of pH and TSS quantity 3.436% and 12.23% respectively. Whereas of high TTA content or malic acid 0.469 gl^{-1}. According to the crude protein and crude fiber higher quantity obtained in sample F with 1.600% and B with 8.310%, respectively. From this study, it could be concluded that the apple samples D, E and F from Barwari Bala (Dohuk) have a good quality and more softness than Haje Omran (Erbil) samples and serve as good supplementary source of essential nutrient in the term of its physiochemical properties.

Keyword: Local apple, Chemical constituents, Physical properties

تقييم الخواص الفيزيائية والكيميائية للتفاح المحلى في اقليم كردستان

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الباحث استاذ مساعد

أربيل/اقليم كردستان/عراق/ قسم الصناعات الغذائية/ كلية العلوم الهندسة الزراعة/ جامعة صلاح الدين

الخلاصة

التفاح فاكهة مهمة مرغوبة للطعم والقيمة الغذائية. الهدف من الدراسة كانت للبحث عن مقارنه تحليلية بين ست نماذج من فاكهة التفاح المحلي: A إيراني احمر، B: فرنسي، C: إيراني اصفر، D ستاريك، E أو F: لبناني احمر : لبناني F) من بروارى بالا في مدينة D-F) كانت مأخوذة من حاجى عمران في مدينة أربيل و (A-Cاصفر)، حيث نماذج (، مجموع pHدهوك ولتحديد الخصائص الفيز والكيميائية (الفيزيائية والكيميائية) مثل محتوى الرطوبة، نسبة الرماد، المواد الصلبة الذائبة، الحموضة الكلية القابلة للمعايرة، بروتين الخام وألياف الخام. من خلال الدراسة بينت النتائج بأن كانت 89.746% و89.066 % المأخوذين من بروارى بالا في دهوك أعلى F وDمستوى الرطوبة في نماذج التفاح من بقية نماذج مما جعلت هذه النماذج أكثر نعومة ولذيذة. لكن محتوى الرماد في عينات دهوك أقل وخاصة في . و لكن في C 1.950%، وبينت الدراسة أن أدنى نسبة رماد كانت في نموذج 1.883% F 1.976 % و Eنموذج والتي كانت 3.436% و 12.23% على التوالي ولكن له TSS وأقل كمية ل pH وجدت أقل قيمة ل Eنموذج . أما بالنسبة للبروتين وألياف الخام أعلى $^{-1}$ للحموضة على أساس حامض الماليك 0.469 غم لترTTAأعلى محتوى 8.130 % على التوالي. وفي هذه الدراسة استنتجنا بأن نماذج التفاح B 1.600 % وفي Fكمية كانت في نموذج) من بروارى بالا (دهوك) ذات نوعية جيدة وأكثر نعومة من نماذج حاجى عمران وبمثابة مصادر تكميلية Fو Eو D(جيدة العناصر الغذائية الأساسية من حيث الخصائص الفيزيائية والكيميائية.

الكلمات المفتاحية: تفاح المحلي، المكونات الكيميائية، الخصائص الفيزيائية

1 Introduction

People in most parts of the world widely consume wild and cultivated edible parts of plants to meet their nutritional requirements, also in Kurdistan Region. Generally, fruits are known as essential for health optimization, with human health depending to a large extent on factors such as high fruit (1).

Fruits have been recognized as important sources for a wide range of non-digestible components and phytochemicals that separately or in a combination that may act synergistically to contribute to the nutritional value and health benefits of these food commodities (2).

Among these fruits' apple is one of the important temperate fruit in terms of human health and for its attractiveness, nutritional value, human diet parts, and is used for many finished products as raw material (3;4).

There are hundreds of apple varieties known to exist worldwide. The main varieties of apple are present in Europe and America are Red Delicious, Golden Delicious, Ida Red, and Green apple. However, Red Delicious, Golden Delicious, Ida Red, and Green apple are the main types that are extant in the

Kurdistan region. These types are different in color, size, shape, flavor, and taste (5).

Apple in its fresh state has been documented for its attractive color, unique taste and smell, enriched minerals, vitamin, and other health beneficial constituents. The apple fruit is being consumed in a greater quantity than in a fresh state while the residue is processed for its juice contents and into its canned and dry products and in the extraction of pectin (6).

In the world, Apple is the fourth most widely produced deciduous fruit and quantitatively is the most consumed fruit in several countries such as Europe and America (7;8). Apples are familiar with a good source of phenolic compounds and antioxidant substances because their consumption is widespread, and they are available in the market throughout the year (9).

The objective of this current study was to determine the physicochemical properties and to report the previous studies on the importance and measurement of physicochemical properties of apple to achieve a complete profile of local apple varieties. The properties that included to study in this work were (moisture content, pH, Ash content, crude fiber content, crude protein content, total soluble solids (TSS), total titratable acidity (TTA)). The obtained results can be used in the registration process of these local varieties and may be taken into consideration in the selection of parents in breeding programs.

2 Material and Methods

2.1 Sample Collection and Preparation

Six variety of apple fruits were used in this study, they obtained and collected between October and December 2020 from the different farm samples (A: Red Irani, B:France and C: Yellow Iranian) at Haji Omran in (Erbil) and samples (D: Staric, E: Red Lebanon and F: Yellow Lebanon) at Barwari Bala in (Duhok) in Kurdistan region. All apple fruits were washed with distilled water to remove all sand and debris then stored in the refrigerator at 4℃ for further analysis

2.2 Materials

The reagents which were used for the analysis of apple samples in this study of high grade and were taken from the Laboratory of Food Technology Department, Salahaddin University and Quality Control Laboratory for food analysis in the Ministry of trade and industry of Kurdistan Regional Government. All the analysis and experiments for the physiochemical properties' determination for the six variety of apple samples were carried out in the two mentioned laboratories.

2.3 Physiochemical Properties Determination

2.3.1 Determination of Moisture Content

Moisture contents of apple samples (A-F) were measured after oven drying using an (Oven LDO - 060E Daihan Labtech CO., LTD). 5 g of each sample was taken and dried at 105 ℃ for about

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8 hs to constant weight (10;11). Each sample was measured three time and moisture content was calculated using the equation below:

Calculation:

Moisture Content% = $\frac{W1-W2}{W1} * 100$

Where:

W_1= weight of sample

W_2= weight of dry sample

2.3.2 Ash Content Determination

The ash content of each apple sample (A-F) was determined using the oven drier (Model: Oven LEF – 215P, Daihan Labtech CO., LTD). 3 g of each sample was ignited in muffle furnace and heated to 525°C for more than 3 h until white to gray color was obtained (12). After cooling to room temperature, it was weighted, then ash content was calculated by this equation:

Ash content % = $\frac{W1}{W2}$ *100

Where:

W_1= weight of ash

W_2= weight of sample.

2.3.3 Determination of pH:

10 ml of the apple juice for each sample (A-F) was dispended into the beaker and their pH were determined by using an electronic pH meter (Model: Thermo – Electron Corporation) (13).

2.3.4 Determination of Total Soluble Solid (TSS)

Total soluble solid content of the apple juice for each sample was determined by using refractometer (Model: HRO32, A. Kruss – Optronic, GERMANY). The results of all sample expressed as soluble solid (Brix %) (14).

2.3.5 Total Titratable Acidity (TTA)

Titratable acidity of each sample was measured by titrating of sample juice with 0.1 N NaOH. Consistently 10 ml of concentrated juice was taken and the volume was made up to 100 ml by adding deionized water in a volumetric flask then 10 ml of diluted juice was titrated with NaOH solution using phenolphthalein as indicator (15). The results were expressed as gram of malic acid per liter of juice (g MA/L).

$$\%TTA= \frac{\{mls\ NaOH\}*\{0.1\ N\ NaOH\}*0.067*1000}{volume\ of\ sample\ ml}$$

Milliequivalent factor of malic acid = 0.067

2.3.6 Determination of Crude Protein

Nitrogen content was measured by using Kjeldahl method and calculated by multiplying the amount of nitrogen by conversion factor 6.25. About 1g of powdered of each apple sample was placed in kjeldahl flask, Kjeldahl digestion tablets and 20 ml of concentrated H_2SO_4 were added. The mixture was digested under boiling at maximum heat until the mixture was clear, and then the flask was distilled using NaOH 40%, the ammonia was

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received in 100ml conical flask containing 10ml of 0.1NHCl and protein content percentage was calculated according to the following equation (16).

%Crude protein=% N × Protein Factor

N=Nitrogen percent

Protein factor = 6.25

2.3.7 Determination of Crude Fiber

Crude fiber of apple samples was determined by using acid/alkali digestion according to the (17). 2 g of each sample was placed into a beaker, 50ml of 1.25% of sulfuric acid solution was added and heated to boil under reflux for 30 minutes. Then quickly the hot solution was filtered, the insoluble matter was washed with distilled hot water. Insoluble matter was quantitatively transferred into a beaker, 50 ml of 1.25% of sodium hydroxide solution was added and also boiled under reflux for 30 minutes then filtered and washed with boiling water. Samples was dried to constant weight in an oven at 100°C, and weighed (W_1). The weighed sample (W_1) was then incinerated in a muffle furnace at 550°C for 3 h, cooled and reweighed (W_2).

The loss in weight on incineration = W_1-W_2

$$\text{Crude fiber \%} = \frac{W1 - W2}{Weight\ of\ original\ sample} * 100$$

Statistical analysis:

Throughout the research, all the results obtained were as mean ± SD. One-way analysis of variance (ANOVA) was used for the statistical analysis of the data using SPSS software (version 26, 2019). Duncan test was used to find the significant differences at $\alpha = 0.01$ between the treatment. All of the experiments were performed in triplicate and mean treatments was calculated.

3 Results and Discussion

3.1 Moisture Content:

Determination of moisture content of an apple plays an important role in the estimating the shelf life and consumable of apple slice. Apple is regarded as highly perishable foods which can be easily deteriorated by different microorganism due to their high moisture content and water (18). Moisture content of the apple samples (A-F) was significantly different among themselves and the results are displayed in **Table and Figure 1.** Sample D scored highest moisture content 89.746±3.398%, whereas sample A showed the lowest 82.613±0.240%. this is compatible with (19) who reported the range of moisture content from (76.69-88.37%). Further, (20) were suggested that the range of moisture content of apple variety was from 83.28% to 89.82%.

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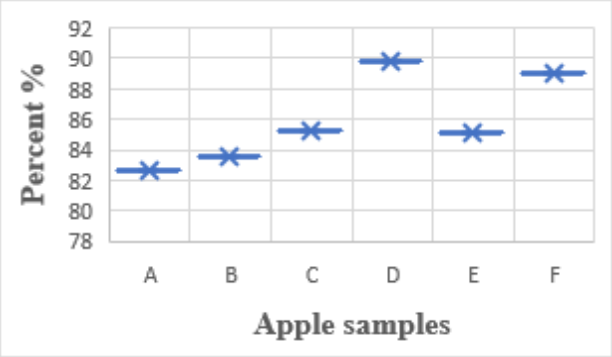

Figure (1): Moisture content of apple samples (A-F).

3.2 Ash Content

Ash content assesses the amount of inorganic elements that present in a material, after burning organic compounds such as carbohydrate, fat and oil the residue will be mostly minerals or inorganic elements. These is a variation in ash content of apple samples (A-F), sample A and B nearly like in ash content 2.326±0.242% and 2.343±0239% respectively. While, sample C with the lowest range as 1.883±0.360% as in Table 1. Similar studies were made by (21) who stated that the ash content in different apple samples ranged from 1.26% to 4.01%. the mentioned results of as content for apple samples are within this range. Earlier works found that total ash content was noted 1.39% (22).

3.3 pH

pH is the measure of acidity or basicity of an aqueous solution. The role of pH in apple and apple juice is important that measures the apple acidity and the concentration of H^+ ions in a cider sample. Also, the pH is associated with bio-chemical reaction which occurs in the fermenting apple juice. The pH of the samples (A-F) was different among themselves. As shown in **Table 1 and Figure 2**. The higher pH value was recorded in sample A 4.053, while the lower pH value was obtained in sample E 3.436. The lower pH values may be due to the gain of acidity. This could be as a result of the much higher pH (lower acidity) of apple juice (23). The results are congruent with (24) who stated that the range of pH of apple juice samples are 3.73 - 4.10. Additional, (25) were reported the pH range from 2.5 - 5.5 which prolong the shelf life of fresh fruit juice and inhibit the growth of some microorganisms.

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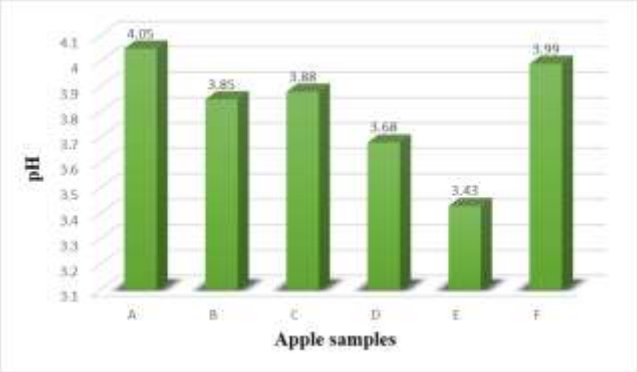

Figure (2): pH value of samples (A-F)

3.4 Total Soluble Solids

Total soluble solid is considered as an important combined index to measure the quality and sweetness of fruits which is essential for consumer acceptance. Total soluble solid values were obtained from apple samples (A-F) ranged from 12.23% to 14.23% when sample F scored highest amount 14.23% whereas, sample E showed lowest quantity 12.23%. Rise in TSS is probably due to hydrolysis of polysaccharides. These results are in agreement with the works reported by (26) who reported the TSS in apple juice 12.27%. Also, a study was carried out on 22 apple cultivars for total solid findings the TSS was listed from 10% - 16.10%. (27) as seen in Table 1. the is congruent with the range above.

3.5 Total Titratable Acidity (TTA)

Acidity is an important property of cider, can easily measure, whether for apple juice making or for mixing fresh juice. Acidity plays a key important role in the flavor and quality of the juices. Malic acid was the major acid which found in one variety of apple juice with concentration of 1738.2 mg/100 ml. (28) indicated that acid content is generally a poor predictor of taste and flavor of apples. Most apple juices of samples (A-F) of a very little acidity, the results which are shown in Table 1. The maximum TTA was recorded in Sample E with 0.469g/L while, minimum quintets of TTA were observed in sample C 0.212g/L. a range of 3.0 g/L to 9.5 g/L titratable acidity has been previously stated in apples by (29). However, (30) was reported that the range of titratable acidity from 0.29g/L to 0.42g/L. So, the TTA of apple juice samples (A-F) approximately within this range

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Table (1): physiochemical properties of apple samples (A-F)

Properties	A (Red Irani)	B (France)	C (Yellow Irani)	D (Staric)	E (Red Lebanon)	F (Yellow Lebanon)
Moisture %	82.613±0.240 a	83.540±0.144 a	85.293±0.262 a	89.746±3.398 a	85.180±0.200 a	89.066±3.777 a
Ash %	2.326±0.242 a	2.343±0.239 a	1.883±0.360 a	2.573±0.156 a	1.976±0.143 a	1.950±0.035 a
pH	4.053± 0.124 a	3.856±0.078 ab	3.880±0.030 ab	3.686±0.114 ab	3.436±0.031 b	3.996±0.151 a
TSS %	14.10±0.00 b	13.00±0.00 d	13.36±0.03 c	14.03±0.03 b	12.23±0.03 e	14.23±0.03 a
TTA g/L	0.424±0.022 ab	0.357±0.022 b	0.212±0.011 c	0.446±0.022 a	0.469±0.000 a	0.223±0.022 c

3.6 Crude Protein

Proteins are nitrogen- comprising substances which are formed by several amino acids. (31). The crude protein content of local apple samples (A-F) under study varied from 0.700% to 1.600%. As seen in Table 2. A higher amount of crude protein was found in sample F 1.600±0.057%. While the lower quantity was scored in sample A with 0.700±0.100%. All of these results are higher than (0.30%) reported by (32). Further, the results are in apple samples agreement with the data obtained by (33) in which were reported that the amount of crude protein content in the three types of apple samples with varying in between 0.43% - 1.21% and 0.12 respectively.

3.7 Crude Fiber

Dietary fiber as non-digestible carbohydrate plus lignin. Apples are good sources of fiber with a well-balanced amount between soluble and insoluble portion (34). Crude fiber content of the local apple samples was significantly different among themselves as shown in Table 2. Sample B of higher percent crude fiber 8.310±0.142%. Whereas, sample A of lower content 3.496±0.247%. An earlier study was found that the crude fiber content of apples is around 1.64% to 1.83% (35).

Table (2): Protein, and fiber percent content in apple samples (A-F)

Parameters %	A (Red Irani)	B (France)	C (Yellow Irani)	D (Staric)	E (Red Lebanon)	F (Yellow Lebanon)
Crude protein	0.700±0.100 c	1.116±0.003 b	1.133±0.033 b	0.860±0.020 c	1.306±0.003 b	1.600±0.057 a
Crude fiber	3.496±0.247 d	8.310±0.142 a	4.003±0.129 ce	4.890±0.200 b	4.500±0.152 bc	5.056±0.033 b

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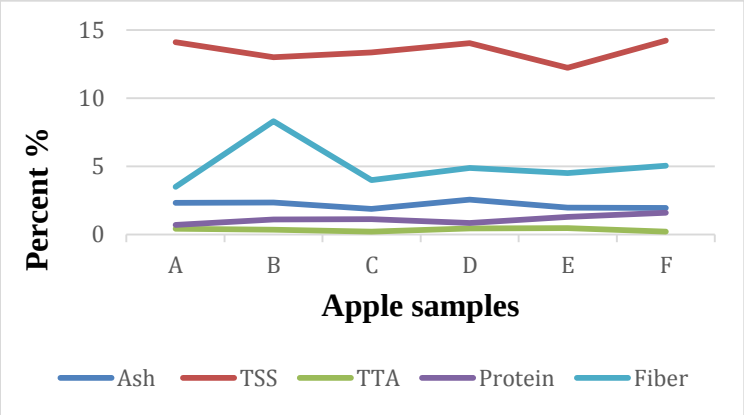

Figure (3): Correlation of ash, TSS, TTA, crude protein and crude fiber of apple samples (A-F).

4 Conclusion

The physiochemical traits were determined for an apple samples from six local varieties of apples developed from Kurdistan Region that collected from Duhok- Barwari Bala and Erbil-Haje Omran areas. Generally, study demonstrated that cultivars grown under Kurdistan conditions diverse widely for physiochemical attributes. This variability may be recognized to the genetic factors and geographical locations. Results from this study have displayed that the physiochemical characteristic of the local apple samples (A-F) differ significantly. The main composition of the apple samples was water (moisture content) with all of the sample holding above 80 percent. Also, other parameters such as ash, TSS and fiber present at high amount. However, pH present at a significant amount within all the samples. Generally, all the apples contain low amount of total titratable acidity and protein. The results of this study demonstrated that the apple samples from Barwari Bala (Dohuk) contains high moisture content this leads to the samples have good quality and more attractive to the consumer also, considerable amounts of essential nutrients and it could be used in the processing of the cider and other food processing.

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