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Qualitative Analysis of Active Materials in Date Samples and Determination of their Essential Components

Samira E. Farahat[1*], Raja A. Allafi[2], Amani Abdusalam Ali[3]
[1] Department of Chemistry, Faculty of Science, University of Gharyan, Gharyan, Libya
[2] Department of Chemistry, Faculty of Science, University of Gharyan, Gharyan, Libya
[3] Department of Chemistry, Faculty of Science, University of Gharyan, Gharyan, Libya

التحليل النوعي للمواد الفعالة في عينات التمور وتحديد مكوناتها الأساسية

سميرة فرحات[1*]، رجاء اللافي[2]، أماني عبدالسلام علي[3]
[1] قسم الكيمياء، كلية العلوم، جامعة غريان، غريان، ليبيا
[2] قسم الكيمياء، كلية العلوم، جامعة غريان، غريان، ليبيا
[3] قسم الكيمياء، كلية العلوم، جامعة غريان، غريان، ليبيا

*Corresponding author: samyrah.mare@gu.edu.ly

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Abstract:
The present study concentrated on samples of Libyan dates procured from the markets in Gharyan City. A series of qualitative analyses were conducted in order to assess the content of their active ingredient, with a particular focus on antioxidants. The qualitative identification of tannins, flavonoids, glycosides, saponins, and resins (utilised as tanning agents) was conducted utilising standard reagents such as Dragendorff's, Fehling's, and Benedict's, in conjunction with date extracts. The analyses confirmed the presence of all these compounds in the samples. Furthermore, quantitative assessments of the fundamental components of the date samples were conducted. The procedure entailed the quantification of fibre, carbohydrates, protein, fat, and ash content. Furthermore, the moisture content and the ratio of pits to fruit were evaluated in all samples. The assessment employed a kiln, a Kjeldahl apparatus, and other requisite equipment to determine the caloric values of each sample. The findings indicated variations in the fundamental components and energy content among the samples, likely attributable to various factors and conditions.

Keywords: Dates, Antioxidants, Free Radicals, Plant Active Ingredients.

الملخص
ركّزت الدراسة الحالية على عينات من التمور الليبية المأخوذة من أسواق مدينة غريان. وقد أُجريت سلسلة من التحاليل النوعية لتقييم محتواها من المواد الفعّالة، مع التركيز بشكل خاص على مضادات الأكسدة. شملت التحاليل النوعية التعرّف على وجود التانينات والفلافونويدات والگلايكوسيدات والصابونينات والراتنجات (المستخدمة كمواد دابغة)، وذلك باستخدام كواشف قياسية مثل كاشف دراجندورف، محلول فيهلنغ، وكاشف بندكت، بالتزامن مع مستخلصات التمر. وقد أكدت النتائج وجود جميع هذه المركبات في العينات. إضافة إلى ذلك، أُجريت تقييمات كمية للمكوّنات الأساسية لعينات التمر، حيث شملت تحديد محتوى الألياف، والكربوهيدرات، والبروتين، والدهون، والرماد. كما جرى تقييم محتوى الرطوبة ونسبة النوى إلى اللب في جميع العينات. وقد استُخدم في هذه التقييمات فرن تجفيف، وجهاز كيلدال، وأجهزة أخرى لازمة لتحديد القيم الحرارية لكل عينة. وأظهرت النتائج وجود تباين في المكونات الأساسية والقيمة الطاقية بين العينات، يُعزى على الأرجح إلى عوامل وظروف مختلفة.

الكلمات المفتاحية: التمور، مضادات الأكسدة، الجذور الحرة، المواد الفعّالة النباتية.

Introduction

The active chemical components of aromatic medicinal plants, including glycosides, alkaloids, essential oils, saponins, phenolic compounds, and others, are produced by direct post-photosynthesis processes. The therapeutic effects of these substances have been demonstrated in the treatment of numerous diseases, with studies showing that they can accelerate recovery and alleviate symptoms. Consequently, these products are designated as active substances [1].

It has been determined that certain plant species possess elevated concentrations of active substances, including antioxidants. A notable example is fresh palm fruits, which have been found to contain a variety of phenolic compounds, such as free phenolic acids (e.g., folic acid) and conjugated phenolic acids (e.g., ferulic acid and gallic acid). Additionally, flavonoids have been identified in several types of palm fruits [1]. Date palm fruits and dates are among the most nutritionally dense fruits, due to their high carbohydrate content, high sugar levels, high water content, and high mineral content. Furthermore, these nuts are notable for their high vitamin content, which includes essential nutrients such as vitamin E and various amino acids. Dates are also among the most calorific fruits, with approximately 3,000 calories per kilogram of pitted dates.

The quantity and quality of active ingredients present within the plant, as well as its composition, are significantly influenced by the specific growth stage and the age of the plant itself. In the case of certain perennial plants, it was observed that the quantity of the active ingredient is subject to variation according to the age of the plant. This amount is known to increase with the age of the plant, after which it gradually decreases over time. The roots of the liquorice plant are not harvested before two or three years have passed since its planting. The Digitalis plant has been observed to produce a greater amount of glycosides in the second year of planting than in the first year. It has been established that the Rhubarb plant (Rheum rhabarbarum) exerts a significant medicinal effect when harvested at a stage of development corresponding to six years of growth [2].

The majority of active antioxidants are phenolic compounds and flavonoids. Phenolic compounds have been demonstrated to be effective inhibitors of lipid peroxidation due to their ability to chelate metals and scavenge radicals [3]. The antioxidant effects attributed to vegetables and various plants are largely attributable to the oxidation and reduction properties of phenolic compounds, which function as reducing agents. Flavonoids and phenolic acids represent a subset of the most potent antioxidant compounds. This process can be achieved through three distinct mechanisms: firstly, by directly displacing free radicals; secondly, by capturing the metals that instigate free radical formation; or alternatively, by inhibiting the enzymes that produce them, thus halting the chain of oxidative reactions.

Flavonoids have been observed to react with numerous free radicals, including hydroxyl radicals, nitric oxide (O2), HO- ions, and ONOO- ions. Flavonoids are subject to oxidation by free radicals, resulting in the formation of more stable, less potent flavonoid radicals. The interaction of these compounds with free radicals is attributable to the presence of hydroxyl groups, which donate an electron to the free radical, thereby increasing its stability.

It is evident that tanins constitute a vital energy source for the completion of metabolic processes within plant organisms. Tannins have been shown to possess antiseptic properties, attributable to their complex phenolic nature, thus protecting plants from a range of bacterial, fungal and viral diseases [4]. Alkaloids have been found in various parts of the plant, including the aerial stems, roots, bark, leaves, and fruits. It has been determined that certain elements are present in all sections of the plant. In certain species of plants, the quantity of alkaloids present in different parts of the plant varies during the growth stages or between night and day. In other species, the amount of alkaloids in a specific organ increases with age [5].

Alkaloids are defined as basic compounds that form salts with acids. The solubility of these compounds in various solvents is dependent on the pH and the basic and salt states. In their basic state, they are soluble in non-polar organic solvents (e.g. ether, chloroform, dichloromethane, benzene), in polar organic solvents (e.g. alcohols), and insoluble in water. In their salt state, these compounds exhibit insolubility in non-polar organic solvents, yet solubility in polar organic solvents. [5, 6]

Free radicals are defined as chemical entities that contain one or more unpaired electrons in their outer shell, a property that renders them highly reactive with more stable biological molecules. These reactive fragments are produced during the process of cellular energy generation using oxygen. In order to achieve stability, these elements interact with biomolecules, which include, but are not limited to, lipids, proteins, nucleic acids and carbohydrates. This interaction contributes to a variety of biological processes, including cell division and programmed cell death. As previously stated, free radicals are naturally generated through biological reactions within the body, which strives to maintain their concentrations. Consequently, low levels of these free radicals in the bloodstream are considered normal and even crucial for several vital cellular functions, such as those involving the immune system, which produces free radicals to help eliminate viruses and bacteria. However, the issue arises when

their levels become excessively high, leading them to attack and damage cellular components, including genetic material, which can disrupt various cellular functions. The accumulation of free radicals has been demonstrated to result in a range of diseases, including degenerative conditions, cardiovascular issues, cancer, and the aging process [7].

In this study, a selection of local varieties available in the markets was investigated by means of an experimental, analytical and deductive approach. A series of qualitative tests were performed in order to identify the active ingredients, and quantitative analyses were conducted to assess the primary nutritional components present in the samples. The objective of the present study was to evaluate and quantify the active ingredient content and caloric value of the samples in question. Furthermore, the moisture percentage was estimated, the kernel-to-fruit ratio was determined, and several active compounds were qualitatively identified, including glycosides, tannins, saponins, flavones, and resins. Furthermore, a quantitative assessment of key nutritional components, including protein, fat, and fibre, was conducted on five types of Libyan dates procured from the markets of Gharyan. In the course of the qualitative analysis, a variety of reagents were employed, including Fehling's and Benedict's reagents. For the quantitative analysis, a dryer was employed to cool the samples away from moisture, while a drying oven, an incineration oven, a seclet device for fat extraction, and a Kjeldahl apparatus for protein estimation were utilized

Material and methods

Materials and Solutions Used:

Certain chemicals were utilized to prepare the reagents for the analysis, as detailed below:

- Hydrochloric acid
- Lead acetate
- Ferric chloride
- Methanol
- Ethanol
- Hexane
- Fehling's solution A
- Fehling's solution B

Sample Collection and Preparation:

In October 2021, a total of five varieties of dates, Saidi, Taqli, Rakli, Abel, and Talis, were selected from local markets. Ripe, premium-quality dates were selected, meticulously cleansed of extraneous dust and impurities, and stored in a refrigerated environment until utilisation

Sample Drying:

Once the samples were gathered and only healthy, fully ripened dates were chosen, they were washed with distilled water, dried, ground, and stored in plastic bags.

Preparation of aqueous extracts of the studied plant:

A total of 40 g of the plant sample was combined with 160 ml of distilled water, thoroughly stirred with a glass rod, and then stored in the refrigerator for 24 hours. Subsequent to this, the mixture was filtered through multiple layers of gauze and subsequently through filter paper to eliminate any uncrushed plant material and residual fibres. The resulting extract was subjected to heating until all the liquid had evaporated, leaving the extract in a solid state at the bottom of the beaker. These extracts were transferred into glass tubes with secure lids and stored in the refrigerator until required [8].

Detection of glycosides:

The Fehling's reagent (A and B) should be combined with the aqueous extracts in equal volumes. The resulting mixture should then be placed in a water bath for a period of 10 minutes. The same procedure was followed using Benedict's reagent.

Tannin Detection:

5 grams of the dried sample were boiled in 25 ml of distilled water and then filtered. Next, 0.5 ml of the boiled solution was transferred into a test tube, followed by the addition of 0.5 ml of lead acetate. In a separate test tube, 0.5 ml of methanolic ferric chloride was combined with 0.5 ml of the boiled mixture.

Saponin Detection:

The aqueous extracts of the dates being examined were shaken vigorously in a test tube, and the outcomes were recorded.

Resin Detection:

2 grams of dried dates were combined with 10 grams of 50% ethyl alcohol and heated in a water bath for 2 minutes. After boiling, the mixture was filtered, and 20 ml of distilled water, adjusted to an acidic pH with a few drops of 4% hydrochloric acid, was added to the filtrate.

Detection of flavonoids:

The initial solution was formulated by the dissolution of 1 g of desiccated dates in 5 ml of 95% ethyl alcohol, which was subsequently filtered following a 6-hour period. The second solution was formulated by combining 10 millilitres of 50% ethyl alcohol with 10 millilitres of a 50% potassium hydroxide solution. The two solutions were mixed in equal proportions, and the results were meticulously documented [8].

Estimating the moisture content of date pulp:

The moisture content was assessed by measuring the weight difference before and after drying at 105°C. Five samples from each batch were weighed (wet weight) and then dried in a vacuum oven at 105°C for 24 hours. Following the drying process, the samples were subjected to cooling in a desiccator for a duration of half an hour prior to undergoing a second weighing procedure. This process was repeated on three occasions to ensure consistent weight stability. The moisture content was calculated using the following equation:

Wet weight / (Dry weight - Wet weight) = % moisture content.

Determining the pit/fruit ratio:

A precise balance was employed to measure a sample of 10 undried dates. The pits were subsequently extracted from the fruit, and the weight of the removed pits was recorded. The ratio of pits to fruit was then calculated [9] using the following equation:

(Weight of pits ÷ Total weight of dates × 100)

Estimating ash content:

The quantity of each date should be measured out at 30 grams. The sample should be placed in a dry, pre-weighed crucible and subsequently inserted into a muffle furnace set to 600°C for a duration of five hours. Subsequently, the crucible should be transferred to a dryer for a period of half an hour, in order to facilitate the cooling process. Finally, the sample should be weighed, and the ash content calculated using the equation [9].

(Ash weight ÷ Sample weight × 100)

Estimating the crude protein content:

The Kjeldahl apparatus was used to determine crude protein levels. This method involves measuring the nitrogen content in the sample and subsequently calculating the protein quantity by applying a specific constant coefficient for each food category. The process is carried out in three main steps, as outlined below.

- **Digestion**:

During this stage, the organic nitrogen present in the sample is transformed into mineral nitrogen, specifically as ammonium hydrogen sulfate, through the use of concentrated sulfuric acid and catalysts such as copper sulfate. The process of digestion continues until the mixture exhibits a change in colour to a brown or transparent pink hue. The duration of this process is typically approximately three hours.

$$\text{Organic N} + H_2SO_{4(\text{Excess})} \xrightarrow[(Na_2SO_4)]{(CuSO_4)} (NH_4)HSO_4 + H_2O + CO_2$$

- **Distillation**:

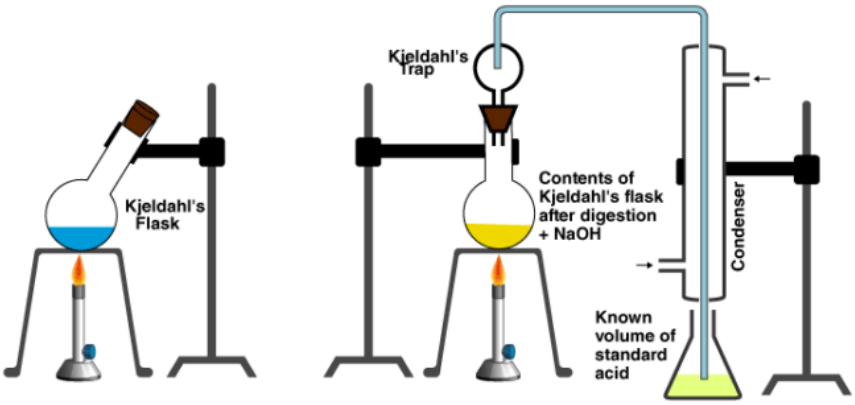
Distillation is carried out with concentrated caustic soda (sodium hydroxide) at a concentration of 40-50% under heat, which facilitates the breakdown of ammonium hydrogen sulfate and the release of ammonia. The ammonia is subsequently diluted in an appropriate acid.

$$(NH_4)HSO_4 + 2NaOH \longrightarrow 2NH_3 + Na_2SO_4 + 2H_2O$$

- **Titration**:

Titration, which involves the dilution of ammonia in an acid, is conducted both directly and inversely to determine the milliequivalents of ammonia generated during the distillation process. In the direct method, ammonia is diluted in 4% boric acid, where a portion of the boric acid transforms into ammonium borate, matching the quantity of ammonia generated during the distillation process.

$$NH_3 + H_3BO_3 \longrightarrow NH4^+ : H_2BO_3^- + 2H_2O$$



(1) Digestion (2) Neutralization % Distillation (3) Titration

Figure 1: Components of the Kjeldahl apparatus.

To determine the milliequivalents of ammonium borate produced, perform a titration using 0.1 N hydrochloric acid and measure the quantity of ammonia.

$$NH_4^+ : H_2BO_3^- + HCl \longrightarrow NH_4Cl + H_3BO_3$$

In this instance, a combined indicator of bromocresol green and methyl red is utilised. Conversely, in the reverse method, ammonia is amalgamated with 0.1 N hydrochloric acid to yield ammonium chloride. It is imperative to ensure an excess of acid in the beaker to avert the complete consumption of the acid through its reaction with the ammonia.

$$NH_3 + HCl \longrightarrow NH_4Cl + HCl_{(Excess)}$$

The surplus hydrochloric acid was subsequently titrated using a 0.1 N sodium hydroxide solution until a pinkish-orange hue was reached.

$$HCl(excess) + NaOH \longrightarrow NaCl + H_2O$$

Protein Estimation Calculations:

First: Direct Method (Reception in Boric Acid)

The nitrogen content of the sample corresponds to the quantity of ammonia produced, which is also equivalent to the amounts of ammonium borate and hydrochloric acid.

Consequently:

Milliequivalents of nitrogen = milliequivalents of hydrochloric acid required for the neutralization. The percentage of nitrogen is calculated from the following equation:

$$N_2\% = \frac{V \times N \times 14.007 \times 100}{W \times 1000}$$

Where:

V is the volume of hydrochloric acid consumed (burette reading).

N is the molarity of hydrochloric acid.

W is the weight of the sample.

Note that when using a blank, the following formula is:

V = volume of the burette for the sample – volume of the burette for the blank.

Second: The indirect method (reception in hydrochloric acid)

In this instance, the quantity of nitrogen present in the sample corresponds to the quantity of ammonia produced. Consequently, the resultant quantity is equivalent to the total amount of acid minus the amount that reacted with caustic soda. Consequently, the following observations can be made: Nitrogen milliequivalents = (Total hydrochloric acid milliequivalents - Acid reacted with caustic soda).

The percentage of nitrogen is calculated from the equation:

$$N_2\% = \frac{[\,(V \times N)_{HCl} - (V \times N)_{NaOH}\,] \times 14.007 \times 100}{W \times 1000}$$

Once the nitrogen ratios have been estimated, the protein ratio is determined using a consistent coefficient for each food type, following the equation [10,11]:

$$\text{PROTEIN \%} = \text{N \%} \times 6.25$$

Weigh 0.5 grams of the dried sample and transfer it to a Kjeldahl flask. Add 8-10 ml of a 40% sodium hydroxide solution. Next, immerse the tip of the condenser in a conical flask containing 5 ml of 4% boric acid along with the specified mixed indicator until the boric acid solution changes to green. Conduct a titration in the receiving flask using 0.01 M hydrochloric acid until the solution turns red. Record the burette reading, then calculate the nitrogen content and subsequently the crude protein content using the previously established equations [12]. The determination of the crude fat content was a multifaceted process, involving several steps. Initially, a 20 g portion of the dried and ground sample was placed in a Soxhlet apparatus. Subsequently, a quantity of petroleum ether in the range of 60-80 mM was introduced into the distillation flask. Subsequent to the attachment of the Soxhlet apparatus to the flask, the setup was transferred to a heating device and maintained at 70 °C for a period of 5 hours, thus enabling extraction to occur. Subsequently, the solvent was meticulously transferred to a pre-weighed and dried beaker, where it was subjected to complete evaporation. The beaker was then subjected to cooling in a desiccator for a period of 20 minutes. Finally, the fat percentage was determined by weighing the residue and calculating it using the appropriate equation.

$$\text{Percentage of fat} = \text{Weight of fat} / \text{Total weight of dry sample} \times 100$$

Estimating the fiber percentage

A 3 g sample of each dried and ground date variety was placed in a 250 ml beaker. To each sample, 200 ml of 0.313 M sodium hydroxide was measured out and added. The mixture was then heated to boiling using an electric heater. The samples were permitted to acclimatise to ambient temperature for a duration of 30 minutes prior to filtration. The precipitate was transferred to a separate beaker using a Buechner funnel and rinsed with 200 ml of 0.2 M sulfuric acid.

The beaker was then placed on a heating device and gently warmed for 45 minutes. Subsequent filtration of the mixture was conducted using a Buechner funnel, followed by rinsing with 0.313 M sodium hydroxide solution, hot water, and ethanol, in that order. The precipitate was subsequently transferred to a pre-weighed beaker and placed in a drying oven for a period of 24 hours. Subsequent to this, the precipitate was weighed and transferred to a pre-weighed, dry crucible. The crucible was subsequently heated in a kiln at 500 °C for a period of two hours. Following a cooling period in a desiccator, the crucible was re-weighed and the fibre content was recalculated [9].

Estimating the Carbohydrate Content:

The carbohydrate content was calculated according to the equation:

$$\text{Carbohydrate (\% = 100 - [Protein \% + Fat \% + Fiber \% + Moisture \% + Ash \%]} \quad [13,14].$$

Estimation of Energy Content: The calorie content of the samples analysed was determined in kilocalories per 100 grams using Atwater factors, which correspond to (9, 4, 4) for fat, protein, and carbohydrates, respectively. These values can also be expressed in kilojoules per 100 grams as (37, 17, 17) for the same components [12-15].

Results and discussion

Detection of Active Ingredients in Date Varieties:

Detection of Glycosides:

After combining equal volumes of Fehling's Solutions A and B with the plant extracts in a water bath for ten minutes, a red precipitate appeared, suggesting the presence of glycosides. This red precipitate could potentially be found in all five varieties of dates. The findings were further validated with Benedict's reagent, which also resulted in a red precipitate. This is expected, as sugars or carbohydrates are the primary constituents of various date varieties and are present in significant amounts.

Detection of Tannins:

The method described above involved the use of two types of reagents, which yielded the following results:

- The presence of tannins was detected using lead acetate, which resulted in the formation of a white, gelatinous precipitate, thereby indicating the presence of tannins in the date samples. The investigation revealed a positive response to the test in all five samples.
- The application of ferric chloride for the detection of tannins resulted in a bluish-green colouration in the date solutions, thereby indicating the presence of tannins [16]. All varieties of

the samples exhibited this bluish-green reaction, thus confirming that the local date varieties (Saidi, Talis, Rakli, Abel, and Taqli) contained significant levels of tannins, which are well-known to be important antioxidants.

Detection of Saponins:

Upon shaking the test tubes with the aqueous extracts from the five different date varieties, a reaction occurred, resulting in foam formation. This foam indicated the presence of saponins in all the date varieties examined. The foam not only formed but also remained for some time after the test was completed.

Detection of Resins:

The detection steps previously outlined were then carried out, leading to the observation of turbidity, which is indicative of the presence of resins in dates. The study revealed a positive reaction to the test from every date variety examined, thus confirming that the presence of turbidity in plant extracts is indicative of their resin content.

Detection of Flavones:

In accordance with the established detection method, the aforementioned steps were executed. The presence of flavones is indicated by a yellow colour, as previously observed in [16,17]. The findings of this study revealed the presence of flavones in the date solutions that were tested, as evidenced by the distinct colour that was observed in all five solution types.

Estimation of the moisture percentage in dates:

As demonstrated in Table 1, the moisture percentages of fully ripe Talis, Sa'idi, and Rakli dates can be categorised as semi-dry or semi-soft, with moisture levels ranging from 15% to 25%. Conversely, Abel and Tiqli dates are categorised as moist or soft, given that their moisture content exceeds 30%.

Table 1: Average moisture content in the studied date varieties (H%).

Date type	Talis	Al-Saidi	Rakli	Taqli	Abel
Humidity % (H%) (1)	22.54%	26.29 %	20.7 %	42.5%	32.71%
Humidity % (H%) (2)	22.18%	23.69%	18.45%	46.41%	29.65%
Average Humidity %	22.36%	24.99%	19.57%	44.45%	31.18%

Furthermore, the findings indicated that the moisture content of dates varies among different varieties, ranging from 19.57% to 44.45%. The sequence in which the varieties are organised is as follows:
Taqli < Abel < Saidi < Talis < Rakli

Determining the percentage of pits to dates

As demonstrated in Table 2, the Libyan date varieties evaluated in this study exhibited a higher flesh-to-pit ratio, indicative of a greater proportion of flesh relative to the pit. Specifically, the Saidi variety exhibited a pits-to-date ratio of 16.42%, while the Rakli, Abel, and Taqli varieties had ratios of 9.61%, 10.33%, and 8.54%, respectively. This finding is consistent with the results reported by [16], who conducted a study on other local Libyan date varieties (Bakrari, Aami, Tabuni, and Fazzani) and found that the proportion of pits was greater than that of the flesh in all varieties analysed.

Table 2: The ratio of pits to dates in the studied dates.

Date type	Total weight of dates (g)	Weight of pits (g)	Percentage of pits to dates
Al-Saidi	76.42	12.55	16.42%
Rakli	71.79	6.90	9.61%
Abel	120.6	12.47	10.33%
Taqli	115.05	9.83	8.54%

The data presented in Table (3) indicates that the percentage of pits in dates differs by type, with values ranging from 8.54% to 16.42%. The types are ranked as follows:

Taqli < Rakli < Abel < Saidi

Ash percentage estimation:

The analysis of ash content across the five samples revealed comparable percentages. The (Saidi) and (Taqli) samples exhibited the highest ash content, measuring at 3.27% and 3.31%, respectively. In contrast, the (Rakli) sample displayed the lowest ash content at 1.06%. The other samples, (Thales) and (Abel), had ash contents of 2.37% and 1.59%, respectively.

Table 3: Ash percentage in the studied dates.

Date type	Ash percentage	Average
Talis	2.35%	2.37 %
	2.40 %	
	2.37 %	
Al-Saidi	3.26%	3.27%
	3.25%	
	3.3%	
Rakli	1.1 %	1.06%
	1.0 %	
	1.1 %	
Abel	1.58 %	1.59%
	1.61 %	
	1.59 %	
Taqli	3.1 %	3.31%
	3.2 %	
	3.1%	
Talis	2.35%	2.37 %
	2.40 %	
	2.37 %	

Protein Content Estimation:

The protein levels in the five samples were relatively comparable, with values varying between 5.06% and 12.45%. Samples 1 and 2, both identified as Tallis, exhibited the highest protein concentrations, measuring 12.45% and 11.6%, respectively. In contrast, Samples 3 and 4, known as Rakli, had the lowest protein contents, recorded at 5.3% and 5.06%. Sample 5 contained a protein level of 7.7%.

Table 4: Protein percentage in the studied samples.

Sample number	Sample	Protein percentage	Average percentage
1	Talis	12.52% - 12.47% - 12.38%	12.45%
2	Al-Saidi	11.68% - 11.52% - 11.65%	11.6%
3	Rakli	5.4% - 5.3% - 5.2%	5.3%
4	Abel	5.07% - 5.11% - 5.02%	5.06%
5	Taqli	7.8% - 7.7% - 7.6%	7.7%

Fat content estimation:

The findings indicated that the various date samples contained minimal fat content. As outlined in Table (5), Sample 1 (Talis) and Sample 2 (Al-Saidi) exhibited high fat levels at 1.25%, while Sample 4 (Abel) displayed a moderate fat content of 1%. Samples 5.3 (Rakli) and (Taqli) had comparable fat contents of 0.52% and 0.75%, respectively.

Table 5: Fat percentage in the studied samples.

Sample number	Sample	Fat weight (g)	Average weight (g)	Fat percentage %
1	Talis	0.2 ----0.3	0.25	1.25
2	Al-Saidi	0.2----0.3	0.25	1.25
3	Rakli	0.06----0.15	0.105	0.52
4	Abel	0.14----0.3	0.2	1
5	Taqli	0.03----0.28	0.15	0.75

Fiber Content Estimation:

The analysis of the five date samples revealed comparable fiber levels, varying between 1.69% and 3.49%. Samples 5 and 3 (Rakli) and (Taqli) exhibited the highest fiber contents at 3.27% and 3.49%, respectively. Samples 4 and 2 (Al-Saidi) and (Abel) demonstrated similar fiber levels, measuring 1.69% and 1.93%. Sample 1 (Thales) had a fiber content of 2.36%.

Table 6: Fiber percentage in the studied samples.

Sample number	Sample	Protein percentage	Average percentage
1	Talis	12.52% - 12.47% - 12.38%	12.45%
2	Al-Saidi	11.68% - 11.52% - 11.65%	11.6%
3	Rakli	5.4% - 5.3% - 5.2%	5.3%
4	Abel	5.07% - 5.11% - 5.02%	5.06%
5	Taqli	7.8% - 7.7% - 7.6%	7.7%

Estimating the Carbohydrate Content:

Once the moisture, protein, fat, fiber, and ash contents have been calculated or estimated, the carbohydrate content can be determined using the following equation:

Carbohydrates = 100 - [Protein % + Fat % + Fiber % + Moisture % + Ash %]

Table 7: Percentage of carbohydrates in the studied samples.

Sample number	Sample	Carbohydrate percentage %
1	Talis	40.79
2	Al-Saidi	42.75
3	Rakli	29.72
4	Abel	40.76
5	Taqli	59.7

Energy Content Estimation:

The findings indicated that the date samples analyzed possessed a high energy content, largely attributed to their abundant carbohydrate levels. Samples 1, 2, and 5, Tali's, Sa'idi, and Taqli, demonstrated the highest energy contents at 224.21 kcal, 228.65 kcal, and 276.35 kcal, respectively. Sample 4 (Abel) had an energy content of 192.28 kcal, while Sample 3 had the lowest energy content at 144.76 kcal.

Table 8: Energy content of the studied samples.

Sample number	Sample	Calories (Kcal/ 100g)
1	Talis	224.21
2	Al-Saidi	228.65
3	Rakli	144.76
4	Abel	192.28
5	Taqli	276.35

The analysis of ash content in the samples indicates the presence of mineral substances, suggesting that the samples analysed contain satisfactory levels of essential minerals, including potassium, calcium, iron, phosphorus, sodium, and magnesium. The findings of this study demonstrate that key nutritional components, such as proteins, fibre, fats, and carbohydrates, vary in proportion among the different types of samples. These variations in percentage results are largely attributable to differences in the samples themselves, the agricultural conditions (including temperature, humidity, and soil), the storage environments, and the timing of the harvest [9].

Table 9: Results of quantitative detection of active ingredients in the studied date samples.

	Talis	Al-Saidi	Rakli	Abel	Taqli
Flavones	+	+	+	+	+
Resins	+	+	+	+	+
Saponins	+	+	+	+	+
Tanins	+	+	+	+	+
Glycosides	+	+	+	+	+

Conclusion

The results of this study, which involved a qualitative analysis of active compounds in different date varieties (Tali's, Saidi, Rakli, Abel, and Taqli), revealed that these dates exhibited positive responses to the majority of the chemical tests performed. The analysis detected the presence of tannins, saponins,

resins, glycosides, and flavones. This outcome is consistent with the findings of previous research conducted in Zliten, which also identified these active groups in other Libyan date varieties

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