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Nutritional and Biological Characterizations of Dragon (Hylocereus undatus) Fruit

By

Sherif S. Ragab **Amal Z. Nasef**

Samar Kamal H.A. Ali **Emad M. El-Kholie**

Nutrition & Food Science Dept., Faculty of Home Economics, Menoufia Univ., Egypt.

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Amal Z. Nasef - Sherif S. Ragab- Emad M. El-Kholie- - Samar Kamal H.A. Ali

Nutrition & Food Science Dept., Faculty of Home Economics, Menoufia Univ., Egypt.

الخصائص التغذوية والبيولوجية لثمار فاكهة الدراجون

أمل ناصف زكى ـ شريف صبري رجب ـ عماد محمد الخولى ـ سمر كمال حسين أحمد على

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ABSTRACT

This study was designed to examine the phytochemicals, biological properties, and chemical composition of dragon fruit. In this experiment, eighteen male albino mice were divided into three groups, each group containing six rats. The first group served as a negative control and received a standard diet. A standard diet containing 2% dragon fruit powder was given to the second group, and a standard diet containing 4% dragon fruit powder was given to the third group. The results indicated that dragon fruit powder contained large amounts of fiber and carbohydrates in the tested samples. There is also a large amount of phenolic compounds and flavonoids in all samples examined. The results of the biological analysis confirmed that dragon fruit powder improves all biological analyses. In conclusion, eating dragon fruit pulp showed beneficial and reduced the risk of disease due to the increased nutritional value of the fruit and its antioxidant properties.

Keywords: Dragon fruit, chemical constituents, phytochemicals, biological aspects.

INTRODUCTION

Belonging to the genus Hylocerous and family *Cactaceae*, the dragon or pitaya fruit is an evergreen, epiphytic, tropical hiking cactus with a triangular fleshy jointed stalk **(1)**. There are three varieties of dragon fruit, inclusive of the one with white pulp and yellow skin. *Hylocereus polyrhizus* (red-flesh with red peeling dragons' fruit) and dragon (white-flesh with red peeling dragon fruit). The extra extensively grown and ate up species of dragon fruit is *Hylocereus undatus*. Because of their extraordinarily attractive organoleptic qualities, the fruits of this species are in extraordinarily restricted furnish on marketplaces (**2)**. This fruit was once undiscovered at the time, however its sensory qualities, whether consumed fresh or used in cuisine, have made it a burgeoning strong point in the wonderful fruit marketplace **(3)**. When fed on fresh, the pulp has a moderate sweetness and is minimal in energy value. Consuming with the flesh, seeds have a rich flavour and are excessive in fats **(4)**. This delicious fruit is no longer only sweet and pleasant; however, it also incorporates masses of water as properly as essential minerals along with a range of nutritious components. Nutrients consist of carbohydrates, polyphenols, thiamine, niacin, pyridoxine, and flavonoids are additionally present. Beta-carotene, lycopene, and nutrition E are additionally current in dragon fruit **(5)**. Forty-eight percent of vital fatty acids, or forty eight percent linoleic acid and 1.5 percent linolenic acid, are observed in pitaya fruit seeds **(6)**. Dragon fruit therefore is able to be used as a provider of functional factors for offering nutrients that should avoid problems related to diet and beautify users' intellectual and bodily fitness **(7)**. Dragon fruit is considerably utilized in many one-of-a-kind meal's items, together with wines, candies, yoghurts, ice creams, pastries, jams, and jellies. This is due to the fact of the fruit's special color-particularly the reddish-purple colorings considered in red-flesh dragon fruit-as properly as its excessive nutritious content material and antioxidant qualities **(8)**. Many nations utilize dragon fruit as a therapeutic plant in their nearby medicine when typical medical practitioner hire herbal redress for the prevention and remedy of illnesses **(9)**. Because dragon fruit has a

large nutrition C content, it aids in the quick recovery of wounds and cuts as properly as the prevention of cough and asthma. But dragons' fruit widespread quantity of vitamin C is crucial for boosting the body's defenses against contamination and promotion the manufacturing of extra antioxidants **(10)**. The pulp and the peels have high water content, are rich in fibers and contain many nutrient elements including a high number of phytochemicals, vitamins, minerals, and antioxidants **(11)**. Numerous research projects with the dragon fruit have highlighted its achievable advantages in reducing glucose ranges in humans with kind two diabetes and reducing the hazard of long-term illnesses in humans **(12)**. By especially activating the intestinal microbiota, dragon fruit oligosaccharide (DFO), that is remote and refined from dragon fruit or pitaya, produces a prebiotic impact that enhances intestine wellness. The movement of the intestinal tract may additionally alternate if the components of the microbiota change **(13)**. Not only does dragon fruit enhance the condition of diabetics, on the other hand it can additionally advantage these who have cardiac disorders, liver, or renal disorders. Dragon fruit decreased blood sugar and more suitable the biochemical markers in rats suffering from diabetes. As such, it qualifies as a vital dietary remedy for humans with diabetes **(14)**.

Therefore, when planning this research, the nutritional value and biological characteristics in rats receiving dragon fruit had been taken into consideration.

MATERIALS AND METHODS

Materials

After being transported below cold conditions from the Horticultural Research Institute, Agric. Res. Centre, Giza, the clean red dragon fruit (*Hylocereus undatus*) used to be retrieved. The dragon fruit samples have been as a result stored at -18 °C till extra characterization.

We bought casein, cellulose, alloxan, vitamins, and minerals from El-Gomhoria Co., for Trading Drugs and Medical Instruments, placed in Cairo, Egypt. We offered oil and maize starch at the nearby market Menoufia, Egypt.

Eighteen (18) Sprague Dawley albino males rat weighing between 150 and 160 g had been bought from the Animal House of Research Institute Ophthalmology in El-Giza.

Standard substances and the Folin-Ciocalteu reagent had been received from Fluka St. Gallen, Switzerland. Milli-Q deionized water was once used to put together all reagents and requirements (Millipore, Bedford, USA). The last chemical compounds and reagents have been obtained from Al-Ghomhoria Co., for Trading Drug and Medical Instruments, Egypt, and had been of the analytical reagent quality. Al-Gomhoria Co. for Trading in Chemical, Drug, and Medical Equipment, Cairo, Egypt, additionally supplied the chemical kits needed to measure glucose, hepatic activity, lipids fractions, and renal markers. **Methods**

Preparation of dragon fruit

A component of the taken fresh fruit was once dehydrated in a warm air dryer at forty-five ranges Celsius for round six hours, then floor into a powder with a milling device determined in the place and saved in plastic sachets at room temperature (25 ranges Celsius to two levels Celsius). After that, the dragon fruit powder samples were stored in storage at -18 °C till they ought to be further examined.

Analysis techniques

We measured the following parameters: Moisture, protein (N x 6.25 Keldahl method), fat (hexane solvent, Soxhielt equipment), fiber, and ash using the procedure suggested by **(15)**.

Carbohydrates and Calori:

Carbohydrate determined using the following differences:

% Carbohydrates = 100 - (% moisture + % protein + % fat + % ash + % fiber).

According to **(16)**, the estimation of energy values was calculated by multiplying protein and carbs by 4.0 and fat by 9.0.

Factors that are anti-nutritional

The technique **(17)** was once used to determine the contents of phytic acid. Method **(18)** was used to analyze the oxalate.

After a few alterations, the **(19)** approach was once used to test the tannin degree of fruits.

The use of saponins was once done in accordance with **(20)**. 10 mg of diosgenin have been dissolved in a combination of sixteen ml methanol and four ml distilled water to create a saponin solution. Vanillin reagent (8%, 0.25 ml) was once delivered to every tube's aliquot, and on the internal wall, sulphuric acid (72% v/v, 2.5 ml) used to be poured gradually. After absolutely combining the solutions, the tubes have been positioned in an Oil bath ONE water tub (Memmert, Germany) set at 60 ranges Celsius. After being incubated for 10 minutes, the tubes had been cooled for 3-4 minutes in an ice-cold water bath. Thermo Fisher Scientific Inc., Philadelphia, USA's Genesys 10 UV was used to quantify the absorbance at 544 nm in comparison to the reagent blank. A solution of 0.1 g of freeze-dried material (80%, 0.1 ml) was made with aqueous methanol. To determine the total saponins at 544 nm using spectrophotometry, 0.25 ml of an aliquot was collected.

Detection of phenolic substances

The technique by using which **(21)** specific the extraction, separation, and size of phenolic elements was once followed. An auto sampler, a column thermostat, and a binary pump made up the Perkin Elmer PE200 HPLC system. A 3200QTRAP MS/MS with ESI ionisation mass spectrometer (Applied Biosystems / MDSSciex, Foster City, USA) used to be utilised. The occasions of the scan were: cellular segment B: 2% acetic acid; gradient elution: zero min 30% A, 70% B; 10 min 30% A, 70% B; 30 min a hundred

percent A, 0% B; 35 min a hundred percent A, 0% B; forty min 30% A, 70% B for machine reconditioning; cellular segment A: 50% acetonitrile, 50% acetic acid (0.5%); 0.7 mL/min float rate; 20 µL injection volume. To create a working standard solution, inventory options of requirements have been diluted in the cell phase. Using calibration curves as a guide, the concentrations of the compounds were decided from the height areas of the chromatogram. The linear regression of the mass of the injected chemical substances vs. its top area used to be used to consider the linearity of the procedure. Prior to use, all solvents had been filtered and degassed and had been of HPLC grade.

Diets

During the seven-day adaptation phase, the rats obtained a standard meal that was once organized in accordance with equation **(22)**; vitamins and salt combinations had been made in accordance with **(23) and (24)**, respectively. The rats have been housed in standard laboratory conditions in wire cages. Rats had been fed the ingredients in specialized feed jars to prevent contamination and feeding losses. Water was once supplied to rats in specific containers. Every day, the meals and water sources have been examined, and the rats had been weighed as soon as per week.

Test-plan design

The Science Research Ethics Committee of the Faculty of Home Economics, Menoufia University accepted the research protocol (#18-SREC-09-2021).

Group 1: Normal, negative-control animals had been given only their basal diet. Group 2: Rats given a base diet supplemented with 2.5% powdered dragon fruit. Group 3: Rats given a base diet supplemented with 5.0% powdered dragon fruit.

Blood testing

The trial lasted for 28 days, after which the rats had been murdered after every used to be in my view weighed. After being placed into sterile, dry

centrifuge vessels and allowed to clot at the ambient temperature, the blood samples have been spun for ten minutes at 3000 rpm to extract the serum. Serum was once cautiously extracted, moved into spotless cuvette tubes, and frozen at -20°C in guidance for trying out the usage of the system outlined through **(25)**.

Biochemistry analysis

The blood sugar degree used to be decided enzymatically using a calorimetric approach in accordance with **(26)**.

Measurement of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in the serum usage of the technique of **(27)**. Serum alkaline phosphatase (ALP) was once measured by the technique of **(28)**.

We used the colorimetric method as described by using **(29)** to determine serum total cholesterol. Using kits, the enzymatic method was once used to determine serum triglycerides in accordance with (30 and 31). While HDL is used to calculate according to the method described by **(32)**. The following calculations have been made for the determination of VLDL-c and LDL-c using the method of **(33)**:

VLDL (mg/dl) = Triglycerides /5

LDL (mg/dl) = (Total cholesterol – HDL) – VLDL

Serum urea used to be calculated the use of the enzymatic approach described in reference **(34)**. Creatinine was once calculated using the methodology described in **(35)**. The serum uric acid was once measured using the calorimetric technique described in reference **(36)**.

Examining statistics

A significant primary factor used to be located, the records have been examined the use of a thoroughly randomized factorial design, and the ability have been separated the use of known as the Student-Newman-Keuls test. The Costat Program has decided that variations between remedies that are

($P \leq 0.05$) significant. To consider the biological outcomes, one way ANOVA was once at first used (**37)**.

RESULTS AND DISCUSSION

Table (1) provides the chemical constitutes of dragon fruit as each it's wet weight and dry weight. It is clear that, in accordance to wet weight measurements, the contents of moisture, protein, fat, fiber, ash, carbohydrates, and energy value were, in that order, 82.71, 0.21, 0.32, 0.03, 0.84, 15.89%, and 67.28 Kcal/100g. Regarding the dry weight, the values for moisture, protein, fat, fiber, ash, carbohydrates, and energy value contents were, in order, 5.72, 1.85, 2.67, 0.17, 4.87, 91.90%, and 389.09 Kcal/100g. These outcomes are constant with those of **(38)**, who noted that the approximate chemical composition of the dragon fruit pulp had been as follows: 87.52g/100 g of moisture, 1.82g of crude fiber, 0.67g of ash, and 1.39g of crude protein per 100 g of moisture. Furthermore, the red dragon's flesh consists of an excellent quantity of imperative nutrients and minerals that are required to enhance overall human health and optimize physiological processes. Therefore, the use of this fruit as a dietary supplement benefits human.

Furthermore, by means of focusing on the factors located in the premature dragon fruit, the nutritional value of the fruit can enhance health advantages and therapeutic potential. According to **(39)**, the red dragon may additionally be considered as a valued industrial commodity.

Table (1): Chemical composition of dragon fruit pulp

Constitutes %	Dragon fruit pulp	
	W/W	D/W
Moisture	82.71	5.72
Protein	0.21	1.21
Fat	0.32	1.85
Ash	0.03	0.17
Fiber	0.84	4.87
Carbohydrates	15.89	91.90
Energy value (Kcal/100g)	67.28	389.09

W/W= Wet Weight DW= Dry weight

The identity of phenolic substances in red dragon fruit pulp was once proven via the information given in Table (2). It is apparent to see that quercetin, coumaric acid, and *p*-coumaric acid have the greatest quantity of phenolic elements in red dragon fruit. The consequences were, in order, 40.27, 38.13, and 12.57 mg/g DW. Conversely, the compounds with the least phenolic content had been observed to be caffeic acid, gallic acid, and chlorogenic acid. 1.70 and 3.81 mg/g DW had been the respective values. Vanillin, however, was once not discovered in these conditions.

Regarding flavonoid concentration, information confirmed that myricetin and catechin had the largest recorded flavonoid contents in red dragon fruit, at 1.27 and 3.71 mg/g DW, respectively. However, rutin and apigenin had the least amounts, measuring 0.50 and 0.38 mg/g DW, respectively. According to **(40)**, phenolic acids are the most common bioactive elements in a variety of fruits, helping these findings. The red dragon's tissue and peeling each had a significant quantity of antioxidants and phenolics.

Red dragons are additionally excessive in phenolic substances, vitamin C, and dyes. Anthocyanins and betacyanins, two naturally occurring dyes in dragon fruit, are aspects of flavonoid compounds with antioxidant properties **(41)**.

Table (2): Identified and quantification phenolic and flavonoid compounds in dragon fruit pulp

Phenolic compounds	**Concentration (mg/g)**
A. Phenolic content	
Caffeic acid	5.20
Gallic acid	3.81
Epi-catechin	17.38
***P*- coumaric acid**	40.27
Vanillic acid	11.47
Vanillin	ND
Quercetin	38.13
Chlorogenic acid	1.70
Ferulic acid	16.32
Syringic acid	12.92
Coumaric acid	21.57
***P*-hydroxybenzoic acid**	10.45
Ellagic acid	17.27
B. Flavonoids content	**Concentration (mg/g)**

Catechin	3.71
Epicatechin	0.56
Rutin	0.50
Myricetin	1.27
Kaempferol	ND
Apigenin	0.38

ND= Not detectable

Table (3) displays the dragon fruit pulp's anti-nutritional factors. The findings acquired indicated that the dragon fruit flesh contained 1.87, 96.74, 0.037, and 1.13 mg/100 g of tannins, oxalate, phytate, and saponin, respectively. These findings are consistent with **(42)** who observed that excessive oxalate consumption might also be damaging to human beings due to oxalosis or the buildup of calcium oxalate deposits in vital organs or tissues. People who go through urinary stones ought to prevent their daily dietary oxalate consumption to no extra than 40–50 mg. For this reason, figuring out a food's oxalate concentration is necessary for those who suffer from renal stones.

Furthermore, most fruits had comparatively low levels of total oxalate approximately 40 mg/100 g fresh weight, except for dragon and star fruits, which had oxalate concentrations of roughly <100 mg/100 g fresh weight **(43)**.

Table (3): Anti-nutritional factors of the dragon fruit

Anti-nutritional	**Concentrations (mg/100g)**
Tannins	١,٨٧
Oxalate	96.74
Phytate	0.037
Saponin	١,١٣

The influence of dragon fruit pulp powder on rats' blood glucose ranges is displayed in Table (4). It is evident that the group rats that received 4.0% dragon fruit had the most elevated serum glucose levels, whereas the negative control group had the least values with statistically significant variations. The average reading was 1102.50 and 98.70 mg/dl, respectively. These findings are consistent with **(44)**, who noted that the effectiveness of red and white flesh dragon fruit may additionally vary due to the fact the glucose-lowering have an impact on of dragon fruit is assumed to be caused through betacyanin and the activity of antioxidants.

Table (4): Effect of dragon fruit on serum glucose of rats

Groups	Parameters
	Serum glucose (mg/dl)
Control (-ve)	$98.70^{c}\pm 0.17$
2.0 % Dragon fruit	$110.50^{a}\pm 0.15$
4.0 % Dragon fruit	$104.18^{b}\pm 0.25$
LSD (P≤ 0.05)	**4.153**

Mean under the same column bearing different superscript letters are different significantly (P≤ 0.05).

The information provided in Table (5) illustrates how dragon fruit influences the rats' liver enzymes (ALP, AST, and ALT). The findings confirmed that the rats in the ALP liver enzyme group given 2.0% dragon fruit had the largest value, whereas the rats in the negative control group had the smallest value, with considerable variance (P≤0.05). The averages had been 102.30 and 111.20 U/L.

Regarding the AST liver enzyme, the information confirmed that the rats given 2.0% dragon fruit had the greatest value, whereas the negative control group had the least AST value with non-significant variations (P≤0.05). The corresponding mean values were 38.13 and 35.62 U/L.

Conversely, the group of rats given 2.0% dragon fruit had the biggest quantity of ALP liver enzyme recorded, whereas the group receiving negative control had the smallest ALP value with significant variations (P≤0.05). These had the corresponding mean values: 167.66 and 150.70 U/L. These findings are in line with **(45)**, which cited that red dragon extracts, each crude

and ethanolic, have been shown to provide safety the liver from damage liver caused through carbon tetrachloride (CCl_4). Nonetheless, the crude extract has a larger hepatoprotective impact versus liver injuries generated by way of carbon tetrachloride (CCl_4) in comparison to the ethanolic extract.

Table (5): Effect of dragon fruit on liver functions (ALP, AST, and ALT) of rats

Groups	Parameters		
	ALP (U/L)	**AST (U/L)**	**ALT (U/L)**
Control (-ve)	$102.30^{c}\pm 8.08$	$35.62^{b}\pm 8.08$	$150.70^{b}\pm 2.08$
2.0 % Dragon fruit	$111.20^{a}\pm 4.93$	$38.13^{a}\pm 0.58$	$161.66^{a}\pm 2.52$
4.0 % Dragon fruit	$106.33^{b}\pm 0.58$	$36.05^{a}\pm 4.93$	$153.35^{b}\pm 4.51$
LSD (P≤ 0.05)	**2.131**	**2.213**	**3.134**

UL= Units/ litter

Mean under the same column bearing different superscript letters are different significantly (P≤ 0.05).

The effects of dragon fruit on rats' total cholesterol and triglycerides are displayed in Table (6). It is evident that the negative control group had the best total cholesterol levels, whilst the 4.0% dragon fruit group had the smallest values with statistically considerable differences. The common values had been 91 and 80 mg/dl, respectively.

Conversely, the group in negative control had the best degrees of triglycerides, whereas the group that consumed 4.0% of dragon fruit had the smallest levels, with extraordinary variations. The average reading was once 75.50 and 66.50 mg/dl, respectively. These findings corroborate the findings

of **(46)**, which indicated that the red dragon fruit, which has a rich phenolic and antioxidant content, significantly impacts the way rats metabolize fat. The red dragon adds to eating diet can raise HDL-c and minimize TC, TG, and LDL-c. The red dragon consumption may want to aid with reducing dyslipidemia due to its effective antioxidant properties and excessive ranges of phenolic compounds.

Table (6): Effect of dragon fruit on total cholesterol and triglycerides of rats

Groups	Parameters	
	TC (mg/dl)	**TG (mg/dl)**
Control (-ve)	$91.00^{a} \pm 0.70$	$75.50^{a} \pm 0.52$
2.0 % Dragon fruit	$84.00^{b} \pm 0.60$	$69.00^{b} \pm 0.70$
4.0 % Dragon fruit	$80.00^{c} \pm 0.80$	$66.50^{c} \pm 2.66$
LSD (P≤ 0.05)	**3.270**	**2.651**

TC= Total cholesterol. TG =Triglycerides.

Mean under the same column bearing different superscript letters are different significantly (P≤0.05).

The results of dragon fruit on rats' serum lipid fractions are displayed in Table (7). It is evident that the negative control group had the best degrees of high-density lipoprotein (HDL-c), whereas the 2.0% dragon fruit group had the lowest values with statistically great differences. 49.15 and 39.50 mg/dl have been the corresponding suggested values.

In contrast, there had been super variants in the low-density lipoprotein (LDL-c) levels, with the biggest values located in 2.0% dragon fruit and the

smallest in 4.0% dragon fruit. 30.70 and 21.70 mg/dl were the average values, respectively.

When it came to very low-density lipoprotein (VLDL-c), the findings confirmed that the negative control group had the biggest levels, whilst the 4.0% dragon fruit group had the lowest ranges with statistically great differences. The averages had been 15.01 and 13.30 mg/dl, in that order. These findings assist **(47)**, displaying that the diet supplemented with red dragon powder may additionally assist decrease cholesterol and elevate HDL-c levels. The pink dragon powder supplemented diet, especially the 6% versions, helps keep away from dyslipidemia.

Furthermore, in hypercholesterolemic rats, feeding with a excessive 10%fruit proportion improves more than a few biochemical indications as well as the lipid fraction. Furthermore, humans with hypercholestreolemic conditions are recommended to consume fruit in its freshest form **(48)**.

Table (7): Effect of dragon fruit on serum lipids profile of rats

Groups	Parameters		
	HDL-c (mg/dl)	**LDL-c (mg/dl)**	**VLDL-c (mg/dl)**
Control (-ve)	49.15^{a}±2.51	26.85^{b}± 0.10	15.00^{a} ±1.51
2.0 % Dragon fruit	39.50^{c}±2.75	30.70^{a} ± 0.12	13.80^{a}±3.20
4.0 % Dragon fruit	45.00^{b}±3.40	21.70^{c}± 1.06	13.30^{b}±2.01
LSD (P≤ 0.05)	**1.271**	**1.270**	**1.662**

HDL-c= High-density lipoprotein Cholesterol. LDL-c =Low-density lipoprotein cholesterol. VLDL-c= Very low-density lipoprotein cholesterol. The means ± standard deviations for every value are proven (n = 3). The

means in the identical vertical column that have the equal letters do not differ significantly at P≤0.05.

Conclusion:

The findings from the study of the chemical composition and biological characteristics of dragon fruit confirmed that it had excessive nutritional value and antioxidant qualities, thereby rendering consuming dragon fruit pulp greater healthful as properly as much less at hazard for disease.

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الخصائص التغذوية والبيولوجية لثمار فاكهة الدراجون

الملخص العربي

تم تصميم هذه الدراسة لتقدير المواد الكيميائية النباتية والخصائص البيولوجية والتركيب الكيميائي لفاكهة الدراجون أو التنين. في هذه التجربة، تم تقسيم ثمانية عشر فأرًا ألبينو ذكرًا إلى ثلاث مجموعات، كل مجموعة بها ستة فئران. كانت المجموعة الأولية بمثابة مجموعة ضابطة سالبة وحصلت على نظام غذائي قياسي. تم إعطاء نظام غذائي قياسي يحتوي على مسحوق فاكهة التنين بنسبة ٢٪ للمجموعة الثانية، وتم إعطاء نظام غذائي قياسي يحتوي على مسحوق فاكهة التنين بنسبة ٤٪ للمجموعة الثالثة. أشارت النتائج إلى أن احتواء مسحوق فاكهة الدراجون على كميات كبيرة من الألياف والكربوهيدرات في العينات المختبرة. كذلك توجد كمية كبيرة من المركبات الفينولية والفلافونيدات في جميع العينات التي تم فحصها. وأكدت نتائج التحليل البيولوجي أن مسحوق فاكهة التنين يحسن جميع التحاليل البيولوجية. في الختام، كان تناول لب فاكهة التنين مفيدًا مرة أخرى وقلل من خطر الإصابة بالأمراض بسبب القيمة الغذائية الزائدة للفاكهة وخصائصها المضادة للأكسدة.

الكلمات الدالة: فاكهة التنين، التركيب الكيماوي، المركبات النباتية الطبيعية، التحاليل البيولوجية.