Utilization of Sprulina Algae to Improve the Nutritional Value of Kiwifruits and Cantaloupe Nectar Blends

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ABSTRACT

In this study use the spirulina which is one of the blue-green algae rich in protein 61.57% and contains a high proportion of essential amino acids (38.81% of the protein) and a source of naturally rich in vitamins especially vitamin B complex such as vitamin B12 (193 µg/100 g) and folic acid (9.66 mg/100 g), which helps the growth and nutrition of the child brain, also rich in calcium and iron it containing (1043.625 and 338.765 mg/100 g, respectively) to protect against osteoporosis and blood diseases as well as a high percentage of natural fibers. So, the spirulina is useful and necessary for the growth of infants and very suitable for children, especially in the growth phase, the elderly and the visually appetite. It also, helps a lot in cases of general weakness, anemia and chronic constipation. Spirulina contain a selenium element (0.0488 mg/100 g) and many of the phytopigments such as chlorophyll and phycocyanin (1.472% and 14.18%), and those seen as a powerful antioxidant. Finally, spirulina called the ideal food for mankind and the World Health Organization considered its "super food" and the best food for the future because of its nutritional value is very high. In this study, products supported with spirulina, kiwifruits and cantaloupe were manufactured. Two types of vegetable and fruit juices, green and were used frequently in commercial manufacturing (cantaloupe - kiwi). Spirulina was added to them at different ratios (zero "control samples", 2.5, 5, 7.5, 10, 12.5 and 15%) The nectar blends were well studied to determine the best percentage of addition and the chemical, natural were done and sensory properties of nectar blends supported by spirulina. The all nectar blends prepared and supported by spirulina were highly accepted. Therefore, it is recommended to use spirulina in the field of strengthening juices, especially the rich types of chlorophyll, anti-oxidant and beneficial to public health such as kiwifruits and cantaloupe.

Key words: Spirulina - Kiwi Nectar - Cantaloupe Nectar - Chemical composition - Nutritional value - Sensory evaluation - Physiochemical characteristics.

Introduction

Spirulina (*Arthrospira platensis*) is a ubiquitous spiral-shaped blue-green microalgae, most commonly found in seawater and brackish water. Among the various species, *S. platensis* and *S. maxima* are the only two used as food. The blue-green color of the organism is due to the presence of various types of photosynthetic pigments like chlorophyll, carotenoids, phycocyanin and phycoerythrin. Phycocyanin is responsible for the blue color of the organism.

Spirulina is an alga containing a valuable combination of substances, including those practically absent in common food. Energetic value of 10 g dried Spirulina powder – 29 kcal: fat – 0.7 g, protein – 5.7 g, carbohydrate – 2.4 g, vitamin A – 57 IU, vitamin B1 – 0.24 mg (thiamine), B2 (riboflavin) – 0.38 mg, B3 (nicotinamide) – 1.3 mg, B6 (pyridoxine) – 0.4 mg, B9 (folic acid) – 9.4 mg, vitamin C – 1 mg, vitamin E –0.5 mg, natrium – 104 mg, potassium – 136 mg, calcium – 12 mg, magnesium – 20 mg, iron – 2.8 mg, zinc – 0.2 mg **Peciukoniene *et al.* (2001)**.

Spirulina fusiformis, a blue-green algae, (Oscillotoreaceae) is rich in proteins, lipids and carbohydrates, as well as elements such as zinc, magnesium, manganese, selenium, and some vitamins including β-carotene, riboflavin, cyanocobalamin, α-tocopherol and α-lipoicacid. Spirulinais also reputed to be an external source of the vital antioxidant enzyme superoxide dismutase **(Upasani and Balaraman, 2003)**.

Chemical analysis of Spirulina showed that it is an excellent source of proteins, vitamins, dietary minerals and pigments. The biochemical composition depends upon the specific Arthrospira source, culture conditions and season of production **Habib *et al.* (2008); Henrikson (2009) and Falquet (2012)**.

The nutrient content of spirulina was analyzed by **Vijayarani *et al.* (2012)** and it contains 6.47 g of moisture, 0.17 g of ash, 347.96 g of energy, 62.4 g of protein, 1.07 g of fat, 22.24 g of carbohydrates, 90.48 mg of iron, 825.1 mg of calcium, 744.39 mg of phosphorous and 3495 µg of carotene.

Spirulina has found wide applications in the areas of agriculture, food, pharmaceuticals, perfumeries, medicine and science. Nowadays, this organism is used as a food supplement and is marketed in the form of pills, capsules and powder or incorporated into various types of food like cakes, biscuits, noodles and health drinks, etc. **Desai and Sivakami (2004)**.

As functional food, additive and prebiotic: Spirulina has earned scientific validation regarding its role as healthy food component. This nutritious and easily digestible food can be consumed in several forms. It was demonstrated that the whole spirulina or

its phycocyanin-rich fraction could be a suitable functional ingredient in soy milk, fruit juices and whole fruits (**McCarty (2007)**. It was suggested that the ingestion of cocoa and spirulina powder mix can promote antioxidant status and vascular health (**McCarty *et al.* (2010)**. Spirulina is expected to enhance the nutritional content of conventional foods when incorporated as colorant, texturizing agent, gelling agent and prebiotic. The pigments phycocyanin and allophycocyanin are used in the food and beverage industry as a natural colorant. This blue colorant finds use in ice cream, sweets, chewing gum, candy, jelly, cake decorations as well as soft drinks, alcoholic drinks (**Liu *et al.* (2012).**

At present, there are two categories of spirulina food. The first is the pills and capsules made from dry spirulina. Food containing spirulina and other ingredients belongs to the other category. Examples are instant noodles, stylish noodles, nutritious blocks, beverages and cookies. The first three food items are recommended luncheon food for middle grade school students by the State Commission of Education Committee **(Li Ding-Mei and Qi Yu-Zao, 1997)**.

The aims of the present work study the chemical, physical, nutrition of characteristics of spirulina, and produce some juices and nectar some juices and nectar blends blends with spirulina.

Materials and Methods

1. Materials:

The raw materials used throughout this study for producing and evaluation of spirulina products were:

1.1. Spirulina: Spirulina was obtained from Aquaculture Research Center at Arab Academy for Science, Technology and Maritime Transport, Arab League.

1.2. Cantaloupe (*Cucumir melon*) fruits were picked at the ripe stage from a certain farm in Ismailia Governorate, Egypt.

1.3. Kiwifruit fruits (**Spanish name):** kiwifruit or kiwi, **Family:** Actinidiaceae, **Genus:** Actinidia, **Species:** A. Deliciosa. Kiwifruit fruits are obtained from local markets in Egypt. The fruits, weighing between 120 to 125 g.

1.4. The starting materials used in preparation of spirulina juices, i.e. sugar, citric acid and sodium bonzaote were obtained from local markets in Quliobia Governorate, Egypt.

2. Preparation and processing:

2.1. Spirulina preparation: Spirulina was cultivated, harvested and dried at Aquaculture Research Center at Arab Academy for Science, Technology & Maritime Transport, Arab League, Then were obtained spirulina dryer, floured and soft and ready for use.

2.2. Cantaloupe: ripe cantaloupe fruits were washed with running water, hand peeled, the seeds were removed, and the flesh was diced. The juices were mechanically extracted by using Moulinex blender (Blender Mixer, type: 741). The puree was strained by 0.023 inch screen to remove stone cells, to avoid coarse pulp particles and to have only fine particles of almost colloidal consistency.

2.3. Kiwifruits: Kiwifruits were supplied by a local producer, fruits were washed, dried in air, hand peeled, seeds carefully removed and cut into small parts. The Kiwifruits puree was extracted by Moulinex blender (Blender Mixer, type: 741). It took five minutes blending to get Kiwifruits puree. The puree was strained by a stainless steel strainer, then strained again by a clean muslin cloth to get rid of seeds and peels for obtaining Kiwifruits puree.

Cantaloupe juice and Kiwifruits purees were divided into two parts:

- The first part was used to determine the chemical composition and sensory evaluation.
- The second part was used in preparation of different nectars blends with dried spirulina powder after that these blends were used for all analysis.

2.4. Cantaloupe nectar: nectar was prepared from the 25% cantaloupe puree to get: total soluble solids 17% and pH 3.5, according to the method described by **El-Mansy *et al.* (2005) and Sharoba *et al.* (2007 and 2012).**

2.5. Kiwifruits nectar: nectar was prepared from the 25% Kiwifruits puree to get: total soluble solids 17% and pH 3.5, according to the method described by **El-Mansy *et al.* (2005) and Sharoba *et al.* (2007 and 2012).**

2.6. Cantaloupe and Kiwi fruits nectar blends: the cantaloupe and Kiwi fruits purees were blended together as follows in Table (A). Each blend was added by 25% to water, sugar and citric acid to production the nectars, and adjusting pH to 3.5 is done conveniently by adding citric acid as 50% (w/v) solution according to **El-Mansy *et al.* (2005) and Sharoba *et al.* (2007 and 2012).**

Table A. Percentage of ingredients used to preapration of cantaloupe and kiwi fruits nectar blends.

Blends No.	Cantaloupe blends		Blends No.	Kiwi fruits blends	
	Cantaloupe puree (%)	Dried spirulina powder (%)		Kiwi fruits puree (%)	Dried spirulina powder (%)
CN1	100	-	KN1	100	-
CN 2	95	5	KN 2	95	5
CN 3	90	10	KN 3	90	10
CN 4	85	15	KN 4	85	15
CN 5	80	20	KN 5	80	20

CN: Cantaloupe nectar. KN: Kiwi fruits nectar.

2. Method of analysis:

2.1. Proximate analysis:

Moisture, crude protein, crude fat, total dietary fibre and ash were determined using the appropriate **A.O.A.C. (2005)**. Carbohydrates were determined by difference.

2.2. Total soluble solids:

The total soluble solids content were determined using a Abbe refrectometer Model 1T AT 20°C according to **A.O.A.C. (2005).**

2.3. pH values:

The pH values were measured by using a pH meter Model Consort pH meter P107.

2.4. Titratable acidity:

Twenty grams of juice, pulp nectar blends samples were mixed with 150 ml of distilled water. The resulting mixture was titrated with 0.1N NaOH solution to pH 6 using a Consort pH meter P107. Results were reported as percent citric acid.

2.5. Ascorbic acid determination:

Ascorbic acid determination using the 2,6-dichlorophenol indophenol dye by titration method of **A.O.A.C. (2005)**.

2.6. Total and reducing sugars:

Total and reducing sugars were determined by Shaffer and Hartman method as described in **A.O.A.C. (2005)** while nonreducing sugars were calculated by difference.

2.7. Total pectic substances:

Total pectic substances contents were determined by the method of Carre and Hayness, which was described by **Person (1976).**

2.8. Determination of chlorophyll and carotenoids:

Fresh samples of red pepper fruit or tomato were homogenized using a pestle and mortar in the presence of water bath contains squash ice. Sixteen milliliters of acetone–hexane (4:6) solvent were added to 1.0 g of homogenated sample and mixed in a test-tube. Automatically, two phases were separated, and an aliquot was taken from the upper solution to measure its optical density (OD) at 663, 645, 505, and 453 nm in a spectropho-tometer. Chlorophyll a, b and β-carotene contents were calculated according to **Nagata and Yamashita** (**1992**) equations:

Chlorophyll a (mg/100 ml of extract) = (0.999 x OD 663) - (0.0989 x OD 645)

Chlorophyll b (mg/100 ml of extract) = (-0.328 x OD 663) + (1.77 X OD 645)

β-Carotene (mg /100 ml of extract) = (0.216 x OD 663 - 1.22 x OD 645 - 0.304 x OD 505 + 0.452 x OD 453).

Chlorophyll a, b and β-Carotene were finally expressed as mg/100 ml.

3. Sensory evaluation:

Sensory evaluation was carried out by a properly well trained panel of twenty adults testers. They were selected if their individual scores in 10 different tests showed a reproducibility of 90%. The 12 members internal panel evaluated the different juices for texture or mouthfeel (smoothness, consistency, and spreadability), color, taste, odor and overall acceptability. Mineral water was used by the panellists to rinse the mouth between samples. Scoring was based on a 100 point scale (10-100) where (90-100) = excellent, (70-80) = very good, (50-60) = good, (30-40) = fair and (10-20) = poor, according to **Onweluzo *et al.* (1999) and Sharoba *et al.* (2007)**.

4. Statistical analysis:

Statistical analysis was carried out using Complete Randomized Design (CRD) giving analysis of variance (AVOVA) for significance at 5% of each treatment. Data of chemical composition of ingredients and blends were expressed as mean of three replicates + standard error (SE). Data for the sensory evaluation of all nectar blends were subjected to the analysis of variance followed by multiple comparison using LSD ($P<0.05$) (**Snedecor and Cochran, 1989**).

Results and Discussion

1. Proximate chemical composition of raw materials:

Spirulina analyzed for moisture, total solids, ash, fat, protein, pH values, fiber, starch, total carbohydrates, amino acids, vitamins and phytopigments and minerals. Results recorded in Tables (1-5) show some chemical and physical properties of starting spirulina material which was used in this study.

Table 1. Chemical composition of spirulina (g/100 g sample).

Components	Values* %
Moisture	**5.37±0.24**
Total solids	**94.63**
Protein*	**61.57±1.61**
Crude fat*	**7.19±0.25**
Ash content*	**7.10±0.09**
Fiber*	**7.93±0.38**
Available carbohydrates*[#]	**16.21**

*** (on dry weight basis)**

[#]: Available carbohydrate by difference

The chemical and nutritional composition of dried powdered spirulina grown in fresh water is summarized in **Tables (1).** It should be noted that, the cell wall of spirulina is composed of protein, carbohydrates and fat. Therefore, the bioavailability of nutrients from spirulina might be more than from other food sources, especially plant food sources.

Spirulina is the richest nutrient and complete food source found in the world. It contains over 100 nutrients, more than any other plants, grains or herbs. Today spirulina is widely used as a food supplement to maintain health, boost energy and reduce weight. Spirulina contains 61.57% protein, higher than any other natural food. Spirulina contains all the essential amino acids in fairly high amounts, spirulina is just that, a complete protein, other protein sources have very negative properties as well, such as animal fat and cholesterol. Spirulina contains essence minerals like calcium, magnesium, potassium, phosphorus, iron, and zinc as well as complete vitamin B groups and many important anti-oxidants (which protect cells). The anti-oxidant phycocyanin can only be found in spirulina. It is the richest natural source of vitamin E and beta-carotene. The results of chemical composition of spirulina are in agreement with those obtained by **Branger *et al.* (2003); Habib *et al.* (2008); Vijayarani *et al.* (2012) and Dolly (2014).**

Spirulina's fat content is only 7.19 %, far lower than almost all other protein sources.

Table 2. Amino acids content of spirulina (mg/100 g).

Essential amino acids	Values	Non-essential amino acids	Values
Isoleucine	**6.78**	**Alanine**	**7.36**
Leucine	**7.67**	**Arginine**	**7.65**
Lysine	**4.37**	**Aspartic**	**11.17**
Methionine	**2.39**	**Cysteine**	**1.28**
Phenylalanine	**4.42**	**Glutamic**	**13.79**
Threonine	**4.88**	**Glycine**	**5.24**
Tryptophan	**1.93**	**Histidine**	**2.71**
Valine	**6.37**	**Proline**	**4.35**
		Serine	**4.16**
		Tyrosin	**3.48**
Total EAA	**38.81**	**Total NEAA**	**61.19**
% Protein	**61.57**		

Vitamin B-12 and B-complex vitamins: Spirulina is the richest source of B-12, higher than beef liver, chlorella or sea vegetables. B-12 is necessary for development of red blood cells, especially in the bone marrow and nervous system. Although primary B-12 deficiencies, pernicious anemia and nerve degeneration, are quite rare, because B-12 is the most difficult vitamin to get from plant sources, vegetarians have taken to spirulina. Ten grams contain 1930 µg of Vitamin B-12.

One gram provides significant quantities of thiamin (5.61 mg), riboflavin (4.94 mg) and niacin (17.19 mg). Spirulina is a richer source of these vitamins than common whole grains, fruits and vegetables and some seeds. Other B vitamins, B-6, niacin, biotin, panthothenic acid, folic acid, inositol and Vitamin E are also present in smaller amounts.

Table 3. Vitamins and phytopigments in spirulina*.

Vitamins	Value	Phytopigments	(%)
Vitamin B1(Thiamine)	**5.61 mg**	**Total Carotenoids**	**0.551**
Vitamin B2 (Riboflavin)	**4.94 mg**	**Beta carotenoids**	**0.243**
Vitamin B3 (Niacin)	**17.19 mg**	**Xanthophylls**	**0.271**
Vitamin B6 (Pyridoxine)	**0.87 mg**	**Zeaxanthin**	**0.128**
Vitamin B12 (Analogue)	**193 µg**	**Chlorophyll**	**1.472**
Folic acid	**9.66 mg**	**Phycocyanin**	**14.18**
Inositol	**58.39 mg**		
Vitamin E	**9.57 mg**		
Vitamin K	**1124 µg**		
Pantothenate	**136 µg**		
Biotin	**8.32 µg**		

**** Value represents average of three determinations***

Calcium, magnesium, zinc and trace minerals. Spirulina is a concentrated calcium food, supplying more, gram for gram, than milk. Ten grams supply 104.3 mg of calcium. Ten grams supply 0.14 mg of

magnesium, one of the most concentrated magnesium foods. Magnesium facilitates absorption of calcium and helps regulate blood pressure. While, spirulina is low in sodium. Humans need dozens of essential trace minerals for the functioning of enzyme systems and many other physiological functions. Deficiency of trace minerals in the typical diet are thought to be widespread. Ten grams supply manganese (0.7 mg), chromium (0.04 mg), selenium (0.005 mg), copper (0.15 mg) and zinc (0.44 mg).

Table 4. Minerals content in spirulina (mg/100 g).

Macro-elements	Value	Micro-elements	Value
Ca	**1043.625**	**Cu**	**1.5071**
K	**2185.744**	**Fe**	**338.765**
Mg	**1.4759**	**Mn**	**7.0194**
Na	**1510.168**	**Zn**	**4.4924**
P	**1917.718**	**Cr**	**0.403**
		Se	**0.0488**
		B	**3.565**
		Mo	**0.4613**

** Value represents average of three determinations*

Physicochemical properties of kiwifruits juice and cantaloupe puree:

The results of the physico-chemical characterization of kiwifruits juice and cantaloupe puree are shown in **Table (5)**. The values obtained for purees are similar to those reported elsewhere (**Cassano *et al.*, (2007)**. Numerous reports on the chemical composition of kiwifruits juice and cantaloupe puree have appeared in the literature but refer to old cultivars which are used less and less by industry. Hence, there is a need to characterize new varieties of kiwifruits juice and cantaloupe puree, which have been utilized by the food industry for some years. These results of kiwifruits juice and cantaloupe puree are in agreement with those obtained by **Connie *et al.*, (2006), Cassano *et al.* (2007) and Jurmkwan *et al.* (2008)**

Data recorded in **Table (5)** show the chemical properties of fruits puree. The solids content is an important factor in the production of nectar. It is well known that the higher the total solids the better will be the quality of the end product. From the tabulated data it is clear that the moisture content in the prepared fruits puree was ranged from 88.76% in kiwifruits juice to 89.84% in cantaloupe puree, while the total solids were ranged from 11.24% for kiwifruits juice to 10.16% for cantaloupe puree. Results appeared that cantaloupe puree has low percent of ash content 0.485%, while kiwifruits juice had the high percentage of ash content 0.645%. The highest percent of ash in this fruits puree encourage to use these fruits as the main component in the preparation of nectar. Also, these fruits had high values of total soiled. Moreover kiwifruits juice and cantaloupe puree were found in the market at most time in the year in contrast with some other vegetables and fruits, behind the price of cantaloupe fruits were suitable for all family in Egypt.

Regarding for fat content in the results, data indicated that each of fruits has less than 1%. Also the same results for protein levels were less than 1%. Carbohydrates are considered as one of the most important quality parameters for fruits and the contributing influence of palatability, quality and formation of discoloration, process ability and viscosity. It was estimated as total sugars, reducing sugar, non reducing sugars and pectic substances. Values of these data are tabulated in the **Table (5)**. The highest percentage of sugars was found in kiwifruits juice, followed by cantaloupe puree.

Pectic substances are the main factor which greatly influences the quality, stability, process ability and viscosity of prepared fruits nectars. The total pectic content of fruits was the sum of the pectin fractions extract; water extract, ammonium oxalate extract and acid extract. Total pectic substances were ranged from 1.56% in kiwifruits juice and 1.25% in cantaloupe puree. The pectin can hold the water in stomach. So, pectin is very important for sportiest and children especially when thy have diarrhea. On the other hand, cantaloupe puree had the higher level of fiber (0.68%) followed by kiwifruits juice (0.65%).

The titratable acidity and pH values are considered as important factor correlated to the quality and flavor of fruits. As shown in the **Table (5)** the pH values were 5.26 for kiwifruits juice and 6.45 in cantaloupe puree, the important of pH values when the food was treated by heat to preserve it.

As known that carotenoids and chlorophyll help the peoples as color to attract any food. Also, epidemiological studies have shown that increased consumption of fruits is associated with reduced risk of lung and other epithelial cancers. It has been suggested that high carotenoid levels in fruits are responsible for this reduced risk.

Fruits products are considered as a good source of vit. C. The results obtained in **Table (5)** showed that all fruits under investigation contained the good percent of vit. C.

Nutritional value was estimated by determining the gross chemical composition, as well as the foods sensory characteristics of different samples were also evaluated. The results of chemical composition and physical properties for ingredients

used for the preparation of fruits nectar formulas were in agreement with those obtained by **Connie *et al.* (2006) Cassano *et al.* (2007) and Jurmkwan *et al.* (2008).**

Table 5. Physicochemical properties of kiwi fruits juice and cantaloupe puree*.

Components	Mean values	
	Kiwi fruits juice	Cantaloupe puree
Moisture %	**88.76 ±1.26**	**89.84 ±1.49**
Total solids %	**11.24**	**10.16**
Ash %	**0.645±0.004**	**0.485±0.006**
Titratable acidity % (as citric acid)	**0.189±0.001**	**0.127±0.001**
pH value	**5.26±0.02**	**6.45±0.03**
Ascorbic acid (mg/100 ml)	**52.68±1.78**	**45.24±2.07**
Protein %	**0.986±0.002**	**0.965±0.003**
Fat %	**0.327±0.004**	**0.265±0.003**
Fibre %	**0.658±0.003**	**0.689±0.002**
Total sugars %	**6.734±0.024**	**6.307±0.035**
Reducing sugars %	**4.801±0.017**	**4.675±0.019**
Non-reducing sugars %	**1.933**	**1.632**
Total pectic substances %	**1.561±0.007**	**1.246±0.009**
Carotenoids (mg/L)	**3.96±0.002**	**4.68±0.006**
Chlorophyll (mg/L)	**17.78±0.021**	**14.92±0.013**

**Each value is the average of three replicates ± S.E. (on wet weight basis).*

Some physical and chemical characteristics of cantaloupe and Kiwi fruits nectar blended with spirulina by different percent:

Moisture, crude protein, fat, crude fiber, ash, sugar, pectin and vit. C which were thought to be great importance in the characterizes where determined.

The fruits nectar enhancement by spirulina (as a source of protein) formulas were prepared to produce as complementary beverages for classes for all human beings who need to increase the protein in their food such as sportsmen's, infants, children, pregnant and lactating women and patients. Prepared fruits nectars were make by using cantaloupe and kiwi fruits fruits. The visibility of chemical composition is too important. Data in **Table (6)** indicated that moisture and total solids content in prepared fruits nectar blends nearly varied. This is due to the adding different rate of spirulina. Control sample of cantaloupe and kiwi fruits nectars had the lowest level of ash content followed by other blends. Fat in all formulas was ranged between 1%. The protein content of blends was ranged from 0.331 to 8.763%, especially the nectars content 10% spirulina. These results are in agreement with trend showed by **Osman (2012)** who added soy bean products (as a source of protein) for fruits nectar. Titratable acidity and pH values are important as it affected on the taste and flavor. The pH values indicated that all formulas were acid food. The obtained data indicated that the total sugars were the major component in total solids in all blends and the main source of energy value. The percentages of total pectic substances and fiber content were acceptable and suitable for sportsmen's, infants, children, pregnant & lactating women and patients related to the importance of those for absorptive of water in bodies and excretion. Pectin is very important for children related to hung the water in stomach especially if the children have diarrhea. More over pectin improve the texture of nectar, so the all consumers' can be accepted these nectars.

The level of chlorophyll and carotenoids in cantaloupe and kiwi fruits nectars formulas which contained spirulina was higher than control formulas. Also, data indicated that ascorbic acid in all cantaloupe and kiwi fruits nectars formulas was ranged from 12.2 to 16.38 mg/100 g in all formulas. Energy values for formulate prepared fruits nectar formulas were estimated from the percentage of total carbohydrates, protein and fat contents, the values were ranged between 64.15 and 67.16 cal/100 g nectar formula. These results for the prepared fruits nectar formulas were in agreement with those obtained by **Sharoba (1999), Bahlol *et al.* (2007) and El-Mansy *et al.* (2005)**. Also, the results within the limiting of all Egyptian standards for juices and beverages.

Finally, it could be clear that the prepared fruits nectar blends is covered the daily requirements according to **FAO (2004)**, of fiber, sugar, pectin, calories, carotenoids and vit. C, so it suitable for sportsmen's and babies specially babies suffering from some sub-clinical dieses like (caloric deficiency, dehydration, diarrhea, normal laxation, night blindness and scurvy), also this results noted that. It may be used in dietetic food and by diabetes patients. Finally, suitable for all peoples in all ages. The chlorophyll and carotenoids contents in any fruits nectar enhancement by spirulina formulas. Eating 100 g from any prepared fruits nectar blendes will covered the daily requirements of fiber and carotenoids. It had a high value of vitamin C content. This blend will cover the daily requirements of vitamin C.

Table 6. Some physical and chemical characteristics of cantaloupe and kiwi fruits nectar blended with spirulina by different percent.

Parameters	Cantaloupe nectar (control)	Cantaloupe nectar blended with spirulina		Kiwi fruits nectar (control)	Kiwi fruits nectar blended with spirulina	
		5%	10%		5%	10%
Moisture (%)	82.71 ±1.32	82.47±0.95	82.52±0.94	82.63 ±1.34	82.71±1.07	82.65±1.30
Total solids	17.29	17.53	17.48	17.37	17.29	17.35
Crude protein (%)	0.331±0.003	4.361±0.001	8.763±0.001	0.327±0.002	4.357±0.001	8.759±0.27
Crude fat (%)	0.132±0.001	0.652±0.001	1.226±0.007	0.117±0.004	0.638±0.001	1.198±0.031
Crude fiber (%)	0.208±0.002	0.728±0.008	1.296±0.001	0.214±0.003	0.734±0.008	1.302±0.011
Ash (%)	0.206±0.002	0.694±0.004	1.226±0.007	0.241±0.004	0.7285±0.001	1.261±0.002
Titratable acidity (%)	0.251±0.001	0.246±0.002	0.231±0.004	0.245±0.001	0.245±0.004	0.245±0.001
pH values	3.50±0.03	3.51±0.01	3.51±0.01	3.50±0.02	3.50±0.01	3.51±0.01
Total sugars (%)	6.307±0.015	10.42±0.317	4.32±0.34	6.734±0.012	10.13±0.224	4.12±0.187
Total pectin (%)	0.438±0.008	0.428±0.014	0.422±0.120	0.465±0.004	0.465±0.011	0.465±0.008
Vitamin C (mg /100g)	13.41±1.23	12.58±0.027	12.2±0.088	16.38±0.85	16.16±0.172	16.08±1.04
Carotenoids (mg/l)	1.63±0.002	32.41±1.82	54.11±2.07	1.28±0.001	29.18±1.47	47.33±2.18
Chlorophyll (mg/l)	5.96±0.017	82.47±2.47	122.31±3.82	6.27±0.024	89.21±3.11	118.04±2.98
Energy values (Kcal.)	67.16	66.71	65.008	67.16	65.48	64.158

Effect of adding spirulina on sensory properties of cantaloupe nectar and kiwifruits nectar blends:

Sensory evaluation is generally the final guide of the quality from the consumer's point of view. Thus, it is beneficial to make a comparison between the nectars blends, which were applied. Organoleptic parameters, indicate the possibility of nectar for acceptability. Blending of fruit nectars could be an economic requisite and also needed to improve the appearance, nutrition and flavor. Texture (Mouthfeel), color, taste, odor and overall acceptability of different Kiwi fruits and cantaloupe nectars blends were organoleptically evaluated, the results are here often in **Tables (7 and 8)**. Significant differences among the all tested nectars. Regarding the texture of Kiwi fruits and cantaloupe nectars, results in **Table (7)** reflect that the texture of nectars (10% spirulina) and (12.5% spirulina) had the highest scores compared with the other nectars. There are significant differences among the tested nectars. Regarding the mouthfeel (texture) of kiwi fruits and cantaloupe nectars, results in **Tables (7 and 8)** reflect that the mouthfeel of nectars (7.5% spirulina) and (10% spirulina) had the highest scores compared with the other blends. In the same time the two blends have the higher scores in all other attributes. The lower scores in all attributes were for nectars (17.5 and 20% spirulina, respectively), the results of sensory tests were in agreement with **Fradique *et al.* (2010) and Liu *et al.* (2012)** they were observed that the incorporation of spirulina increases food texture and imparts it a stable color. Sensory analysis also showed better acceptance scores.

Table 7. Sensory properties of spirulina and kiwifruits nectar blends (mean±S.E.).

Nectar blends	Sensory attributes				
	Texture (Mouthfeel) (25)	Color (25)	Taste (25)	Odor (25)	Overall acceptability (100)
Kiwifruits nectar	18.58±0.34^{f}	19.50±0.50^{d}	19.17±0.32^{d}	17.50±0.48^{fg}	83.58±0.45^{e}
KP+ 2.5 % SP	19.58±0.26^{e}	22.25±0.35^{c}	20.50±0.45^{bc}	18.67±0.43^{e}	86.42±0.66^{d}
KP+ 5 % SP	21.25±0.35^{d}	22.83±0.34^{bc}	21.25±0.25^{b}	20.08±0.40^{cd}	89.17±0.69^{c}
KP+ 7.5 % SP	22.25±0.30^{c}	23.67±0.22^{ab}	22.17±0.30^{a}	21.50±0.29^{b}	92.67±0.50^{b}
KP+ 10 % SP	22.67±0.43^{bc}	24.25±0.21^{a}	22.67±0.28^{a}	22.50±0.31^{a}	94.25±0.28^{a}
KP+ 12.5 % SP	23.75±0.25^{a}	20.58±0.54^{d}	19.91±0.31^{cd}	19.67±0.31^{d}	87.17±0.56^{d}
KP+ 15 % SP	23.33±0.19^{ab}	19.83±0.53^{de}	17.58±0.15^{e}	17.92±0.31^{ef}	82.67±0.63^{e}
KP+ 17.5 % SP	23.17±0.17^{abc}	19.33±0.38^{ef}	17.00±0.28^{e}	16.67±0.26^{gh}	79.08±0.47^{f}
KP+ 20 % SP	20.75±0.59^{d}	18.33±0.43^{f}	16.17±0.21^{f}	15.75±0.22^{h}	75.67±0.38^{g}

In conclusion, results for kiwi fruits and cantaloupe nectar blends appear that the nectar blends containing equal percentage of 10% spirulina had the higher score in all attributes and most acceptable to panelists due to better consistency and flavor. This indicates that spirulina, which is higher in all chemical

composition, protein and amino acids, essential fatty acids, vitamins, naturally colloidal minerals, phytopigments, could be blended with kiwi fruits and cantaloupe in the preparation of juices and nectars. The results are in agreement with **McCarty (2007) and McCarty *et al.* (2010)** they were found that the spirulina was improved the quality of fruits juice for their chemical composition, also are agreement with **Akubor (2003) and Jurmkwan *et al.* (2008).**

Table 8. Sensory properties of spirulina and cantaloupe nectar blends (mean±S.E.)

Products (Nectar blends)	Sensory attributes				
	Texture (mouthfeel) (25)	Color (25)	Taste (25)	Odor (25)	Overall acceptability (100)
Cantaloupe nectar	**17.83±0.24^{g}**	**19.00±0.37^{f}**	**19.08±0.31^{d}**	**18.67±0.43^{d}**	**82.75±0.65^{e}**
CP+ 2.5 % SP	**20.08±0.23^{f}**	**20.42±0.31^{e}**	**20.42±0.36^{c}**	**20.50±0.31^{c}**	**86.25±0.46^{d}**
CP+ 5 % SP	**21.50±0.34^{de}**	**21.42±0.29^{cd}**	**21.75±0.35^{b}**	**21.41±0.29^{b}**	**89.92±0.48^{bc}**
CP+ 7.5 % SP	**22.25±0.33^{cd}**	**22.17±0.27^{bc}**	**22.83±0.32^{a}**	**21.91±0.23^{b}**	**92.33±0.67^{a}**
CP+ 10 % SP	**23.25±0.28^{b}**	**22.83±0.24^{ab}**	**22.75±0.30^{a}**	**23.08±0.19^{a}**	**91.25±1.20^{ab}**
CP+ 12.5 % SP	**24.08±0.23^{a}**	**23.25±0.25^{a}**	**21.00±0.35^{bc}**	**21.42±0.19^{b}**	**88.75±0.49^{c}**
CP+ 15 % SP	**23.00±0.28^{bc}**	**21.67±0.28^{cd}**	**19.17±0.32^{d}**	**19.91±0.29^{c}**	**83.08±0.65^{e}**
CP+ 17.5 % SP	**22.08±0.36^{d}**	**21.08±0.19^{de}**	**17.83±0.46^{e}**	**18.17±0.27^{d}**	**79.00±1.19^{f}**
CP+ 20 % SP	**21.17±0.32^{e}**	**19.42±0.38^{f}**	**16.50±0.26^{f}**	**16.58±0.23^{e}**	**74.00±0.58^{g}**

Conclusion

In conclusion, the present data indicated that cantaloupe and kiwi fruits nectars products are relatively higher in their nutritional values and all of these products are considered to be good sources of vit. C for adult man.

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استخدام طحلب الأسبيرولينا لتحسين القيمة الغذائية لبعض مخاليط نكتار الكيوى والكنتالوب

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تم فى هذه الدراسة إستخدام طحلب الأسبيرولينا وهو أحد الطحالب الخضراء المزرقة الغنى جدا بالبروتين (٦١,٥٧%) والمحتوى على كل الأحماض الأمينية المكونة للبروتينات كما أنه يحتوى على نسبة عالية من الأحماض الأمينية الأساسية (٣٨.٨١% من نسبة البروتين) ومصدراً طبيعياً غنياً بالفيتامينات وخاصة مجموعة فيتامين ب المركب كفيتامين ب١٢ (١٩٣ ميكروجرام/١٠٠جم) وحامض الفوليك (٩,٦٦ ملجم/١٠٠جم) الذى يساعد على نمو وتغذية دماغ ومخ الطفل والكالسيوم والحديد بنسب (١٠٤٣,٦٣ و ٣٣٨.٧٦ ملجم/١٠٠جم على التوالى) للحماية من هشاشة العظام وأمراض الدم بالإضافة إلى نسبة عالية من الألياف الطبيعية لذلك فالأسبيرولينا مفيدة وضرورية لنمو الرضع وملائمة جداً للأطفال وخصوصا فى مرحلة النمو وكبار السن وفاقدى الشهية. كما أنها تساعد كثيراً في حالات الضعف العام وفقر الدم (الأنيميا) والإمساك المزمن. كما أن الأسبيرولينا تحتوى على عنصر السلينيوم (٠,٠٤٨٤ ملجم/١٠٠جم) والعديد من الصبغات النباتية مثل الكاروتينات ٠,٥٥١% والكلوروفيل ١,٤٧٢% و الفيكوسيانين ١٤,١٨% والتى تعتبر من مضادات الأكسدة القوية فهما يمنعا الشيخوخة ويشكلا وقاية دائمة من السرطان. والأسبيرولينا تسمى بالغذاء المثالى للبشرية ومنظمة الصحة العالمية تعتبرها "غذاء سوبر" وأفضل غذاء للمستقبل بسبب قيمتها الغذائية العالية جدا. وكالة الفضاء الأمريكية تعمل على مشروع لزراعتها في الفضاء وتعتبرها الغذاء الرئيسى لرواد الفضاء. كل هذا هو ما يجعل الأسبيرولينا أفضل غذاء موجود على الأرض. فهو غذاء كامل يضمن توازن وقلوية الجسم. تم فى هذه الدراسة تصنيع منتجات مدعمة بالأسبيرولينا وهى عصائر ونكتار الكيوى والكنتالوب.

تم إختيار صنفين من عصائر الخضر والفاكهة ذو اللون الأخضر والغير مستخدمة كثيرا فى التصنيع التجارى وهما (الكنتالوب – الكيوى) وتم إضافة الأسبيرولينا لهما بنسب مختلفة (صفر "كعينة كنترول" ، ٢,٥، ٥، ٧,٥، ١٠، ١٢,٥ و ١٥%) وتم تحكيم المنتج حسيا لمعرفة أفضل نسبة إضافة ثم تم بعد ذلك تحليل للعصائر المدعمة بالأسبيرولينا كيميائيا، طبيعيا وحسيا. وكانت المشروبات المحضرة والمدعمة بالأسبيرولينا ذات قبول عال ولذلك توصى الدراسة باستخدام طحلب الأسبيرولينا فى مجال تدعيم العصائر وخاصة الأنواع الغنية في صبغة الكلوروفيل المضادة للأكسدة والمفيدة للصحة العامة مثل الكيوى والكنتالوب .

الكلمات المساعدة: الأسبيرولينا – نكتار الكيوى – نكتار الكنتالوب – التركيب الكيماوي – القيمة التغذوية – الاختبارات الحسية – الاختبارات الطبيعية.