

## AN INVESTIGATION of NUTRITIONAL VALUES of DRIED VEGETABLES

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### Abstract

Nutrition is the essential subject for life. Food processes are developed in the base of some treatments such as drying. In the research, nutritive values of dried eggplant, dried leek, dried cauliflower, dried broccoli were determined after having been dried under sunlight or in the greenhouse due to season or weather conditions. Investigated main nutrients of dried eggplant were as follows; thiamin (B1), riboflavin (B2), retinol (A), pyridoxine (B6), ascorbic acid (C), folic acid, magnesium (Mg), potassium (K), sodium (Na), phosphor (P), zinc (Zn), ferrous (Fe), copper (Cu). In the study, same food components of dried leek, cauliflower and broccoli were established except phosphorus (P) and copper (Cu) values but niacin and calcium (Ca) values were present. Conditions of drying process are exposed to some factors such as heat, air oxygen and sun light that affect the nutrients especially vitamins. The increase of dried weight of investigated vegetables cause the nutrients to concentrate in dry basis. Studied dried vegetables should generally contribute to nutrition level because of their maintained nutrient compounds.

**Keywords:** Drying, nutrition, vitamins, minerals, process

## KURUTULMUŞ SEBZELERİN BESİN DEĞERLERİ ÜZERİNE BİR ARAŞTIRMA

### Özet

Beslenme hayat için elzem olan olgudur. Gıda prosesleri kurutma gibi çeşitli gıda işlemleri bazında geliştirilmektedir. Araştırmada kurutulmuş patlıcan, pırasa, karnabahar ve brokolinin besin değerleri mevsim ya da hava koşullarına bağlı olarak güneşte veya serada kurutulduktan sonra belirlenmiştir. Kurutulmuş patlıcanının araştırılan başlıca besin öğeleri; tiamin (B1), riboflavin (B2), retinol (A), pridoksin (B6), askorbik asit (C), folik asit, magnezyum (Mg), potasyum (K), sodyum (Na), fosfor (P), çinko (Zn), demir (Fe) ve bakır (Cu)'dır. Çalışmada kurutulmuş pırasa, karnabahar ve brokolide aynı bileşenler P ve Cu hariç ancak niacin ve Ca dahil olmak üzere saptanmıştır. Kurutma işleminin koşulları ısı, hava oksijeni ve gün ışığı gibi çeşitli fiziksel faktörlere maruz kalmaktadır. Araştırılan sebzelerin kuru maddelerindeki artış, kuru madde bazında besin öğelerinin konsantrasyonuna neden olmaktadır. Çalışılan kurutulmuş sebzeler genellikle besin bileşenlerini koruduklarından beslenme düzeyine katkıda bulunmaları gerektir.

**Anahtar kelimeler:** Kurutma, vitaminler, mineraller, işleme

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## INTRODUCTION

Vegetables play an important role especially in Mediterranean nutrition tradition which is accepted as the most healthy nutrition style in the world. There are lots of factors affecting nutrition levels, food supplying, cooking and even amount of getting of foods etc. (1). Reported relationship between nutrition knowledge and food intake and results of their research has shown that the results provide strong evidence for an association between nutrition knowledge and intake of fruit, vegetables and fat.

On the other hand, ecology; climate conditions, soil, habitats, and geography affect the agriculture of lands, countries, established food supplying and nutrition of societies. Turkey has very positive and sorts of ecological conditions that can have vegetative regions all over the country. This is very great fortune for the country. Food industry is one of the industrial branches, which is based on agriculture. It must be well known that supplying food and water items are the reasons of life and also reasons of the wars all over the world. Today food industry develops very fast. Food preservation is an essential and significant principle of food industry. Food preservation provides the foods long shelf life and manufacturing new food products those of are not similar to the original source of raw materials of foods such as tomato paste, wheat flour, beer, wine, cheese etc. The main food preservation techniques are drying, canning, pickling, binding water in brine or sugar syrup, concentrating, heat treatments; sterilization, pasteurization, high pressure practices, or other advanced and nanotechnologies (2). Food preserving techniques are developed upon food chemistry and food microbiology sciences since preventing food has destroying factors such as decreasing of moisture content of foods that cause reducing biochemical and microbiological and enzyme activity and other oxidation of unsaturated lipids, or other oxidative damages of food components such as pigments, carbohydrates (3, 4, 5, 6). The growing proportion of processed foods in the average daily diet in industrialized countries is considered as a challenge to the food industry, not only to provide more variety to the food assortment, but also to cope with high nutritional quality standards (7). When applying food processes, keeping nutrition value, quality

of foods and also providing economic value are main subjects in the food industry. Food production must be a vital issue of the countries when keeping at least 20 countries suffering from starvation and famine in the mind. It is well known that climate change due to global warming affects food production, food safety, and nutrition value, economical levels of families especially in the rural areas even women and children rights (8, 9). Drying of vegetables is a very common food process during which dried vegetables are exposed to some of physical factors; such as, oxygen exposure, and sun light etc. (10). Traditional drying system has some of disadvantages that are far from food safety since it is exposed to wheatear conditions, every contamination, insect and rodent invasion and it is completed at least 8-10 days, whereas some dehydration techniques such as drying in green house, solar panel and oven, are healthier, safer and faster than traditional drying (11).

When the literature was examined there were less articles about nutrition values of mentioned dried vegetables. Consumption of vegetables in preventing cardiovascular disease, cancer, obesity and even osteoporosis is really important (12).

Broccoli (*Brassica oleracea* var. *italica*) has functional properties; preventing cancer, cardiovascular diseases. Broccoli antioxidants and anticarcinogenic components are glucosnolates, polyphenols and selenium (13-16). Broccoli can accumulate Se that is a key trace element for animals and humans, whose biological relevance is evidenced by its inclusion in the genetic code as the seleno-amino acid selenocysteine, being the only trace element specified by it (16, 17). Determined that processed and freeze-dried broccoli samples had important higher contents of mentioned functional compounds.

The nutritional quality of minerals in food depends on their quantity as well as their bioavailability. The bioavailability of key minerals such as iron, zinc and calcium is known to be significantly affected by the fiber, phytic acid, and tannin content of foods. Concentrations of these constituents are altered by various processing methods including milling, fermentation, germination (sprouting), extrusion, and thermal processing. Vitamins, especially ascorbic acid, thiamin and folic acid,

are highly sensitive to the same processing methods. The time and temperature of processing, product composition and storage are all factors affecting vitamins status foods thus retention of nutrients in dried foods should be supported, they should be stored in a cool, dark, dry place and used in a year (18).

## MATERIAL and METHODS

Organic eggplant dried in the greenhouse, eggplant dried under the sun, natural cauliflower dried in the greenhouse, natural leek dried in the greenhouse, natural broccoli dried in the greenhouse were materials.

### Methods

Investigated main nutrients of dried eggplant were as follows; thiamin, riboflavin, retinol, pyridoxine, ascorbic acid, folic acid, Mg, K, Na, P, Zn, Fe, Cu. In the study, same food components of dried leek, cauliflower and broccoli were investigated except P and Cu values but niacin and Ca values were present.

*The vitamin analysis* was made according to these methods: B1, B2, B6 (19-23). (Finglas ve Foulk, 1984; Kamman and et al., 1980; A vitamin, Manz and Philip, 1998; AOAC, 2000; folic acid R-Biopharm Art. No.: 1002, AOAC, 2005; 999, 985.35).

*Mineral analysis* was carried out according to the AOAC standards (1990). Ash was dissolved in 5 ml 20 % HCl, diluted and filtered through 0.45 µm pore size filter. Lanthanum was added to overcome interferences for Ca and Mg determination. Minerals were established by AAS (atomic absorption spectrophotometer) except for Na, K which were detected by FES (flame emission spectrophotometer) (23).

## RESULTS and DISCUSSION

Vitamin and mineral analysis were made tree replicates and they are given in Table 1.

Organic eggplant samples which were dried in greenhouse and under the sun and winter vegetables; cauliflower, leek and broccoli were dried by greenhouse supported with solar panel in the research.

Table 1. Food compounds of dried eggplants (<sup>1,2</sup> DB<sup>\*\*\*</sup>)

Compounds	<sup>1</sup> .d. Eggplant	<sup>2</sup> .Eggplant
*Thiamin	0.25	0.26
*Riboflavin	0.39	Tr
**Retinol	1.88	4.73
*Pyridoxine	0.39	Tr
*Ascorbic A.	21.18	30.34
**Folic A.	30.04	29.28
*Mg	2183.5	1868.5
*K	28465	27450
*Na	7026.5	6153
*P	365.9	273.9
*Cu	10.98	9.50

\*: mg/100g. \*\*: µg/100g \*\*\* <sup>1,2</sup> Dry basis (DB). They were studied as replicate. <sup>1,2</sup> Eggplant dried in the greenhouse, <sup>2</sup> Eggplant dried under the sun

Thiamin (B1) contents of dried leek were established the highest as 0.29 mg/100g. (table 2). B1 contents of the samples change between (DB, the mg/100g. 0.16-0.29). Thiamin also known as: Vitamin B1 and its functions are Coenzyme in the metabolism of carbohydrates and branched chain amino acids.

Infants 7-12 months; Recommended Daily Intake (RDI); 0.3 mg/d, 7-12 months, 0.3-0.5 mg/d, 1-8 years; 0.9- 1.2 mg/d (9-18) years; for females, 1.2, for males mg/d, (18- >70) years; 1.2 mg/d for males, mg/d for female. Sources of this vitamin are whole-grain products; bread and bread products, mixed foods whose main ingredient is grain and ready-to eat cereals (24).

Thiamin is one of the sensitive vitamins against sun light, heat oxygen exposure and also sulphurdioxide treatments (8, 25, 26).

Riboflavin values of the research samples change between (DB, mg/100g, tr-0.39). (Table 1, 2). Recommended daily intakes of B2 are as follows: (RDI); 0.4 mg/d, infants 7-12 months, 0.5-0.6 mg/d, 1-8 years; 0.9- 1.3 mg/d (9-18) years; 1.3 mg/g, for males mg/d, (18- >70) years;1.0- 1.1 mg/d mg/d for females. Investigated plant products should not be very good source of riboflavin. Functions of B2 are Coenzymes in numerous redox reactions. Main sources of B2 are Organ meats, milk, bread products and mushrooms.

Retinol (vitamin A), contents of dried eggplants were (µg/100g.DB); 1.88 -4.73. (Table 1.) RDI of 7-12 months and 500µg/g, 1-9 years are 300-400 µg/g, 9-18 years, 600-900 µg/g, 18->70 years 900

Table 2. Food compounds of dried winter vegetables (<sup>3,4,5</sup>DB<sup>\*\*\*</sup>)

Compounds	<sup>3</sup> Dried Cauliflower	<sup>4</sup> Dried leek	<sup>5</sup> Dried broccoli
*Tiamin B1	0.16	0.29	0.18
*Riboflavin B2	0.21	0.21	0.27
*Pridoxin B6	1.27	0.63	0.44
**Folic acid	214.30	115.25	188.84
*Niacin	7.1	4.4	6.12
*Mg	207.66	205	219.3
*Ca	226.55	467.6	211.85
*K	3658	3207	3314.5
*Na	155.95	240.65	169.05
*Zn	4.10	2.83	3.96
*Fe	14.27	8.19	12.57

\* mg/100g \*\* µg/100g, \*\*\* <sup>3,4,5</sup>Dry basis (DB). They are studied as replicate.

µg/g, for males, 18-> 70 years were 900-700 µg/g, for females. Dried eggplants had insufficient quantities for nutrition when RDI values were examined and values of retinol were determined. Retinol has very important functions in the body such as, gene expression, antioxidant activity, vegetables embryonic development and immune function, saving epithelium and it is required for normal vision (3, 24, 27).

B6 (pyridoxine) B6 mg/100g (0:44 to 1:27) were established and the highest value belong to cauliflower. (DB; 1.27mg/100g). RDI of 7-12 months and 0.3 mg/g, 1-9 years are 0.5-0.6 mg/g, 9-18 years, 1.0-1.3 mg/g, 18->70 years 1.3-1.7mg/g, for males, 18-> 70 years were 1.3-1.5mg/g, for females.

Vitamin B6 comprises a group of six related compounds: pyridoxal, pyridoxine, pyridoxamine, and 5'-phosphates (PLP, PNP, PMP). its functions are coenzyme in the metabolism of amino acids, glycogen and sphingoid bases. No adverse effect was determined (24, 27).

Edible mushrooms are good sources of the B group vitamins and nutritive minerals thus mushrooms can be recommended for balanced and functional nutrition (25, 26).

Quantities of ascorbic acid (vitamin C) were found as 21.18-30.34 DB mg/100g. These quantities were obtained beside dried eggplants which are exposed to destroying factors such as air oxygen, heat. It is known that vitamin C is the most sensitive vitamin against process conditions (3, 26). Sources of ascorbic acid are fresh vegetables and fruits; citrus fruits, potatoes, brussel sprouts, cauliflower, parsley, green pepper, broccoli, strawberries,

cabbage and spinach. It has lots of biological functions in the organism preserve immune system, preserving collagen tissues, cofactor, and antioxidant activity daily intake of vitamin C is 75-90 mg/d.

The eggplant had the lowest content of folic acid as DB µg/g 30.04-29.28, so it is insufficient source of this vitamin (Table 1). But on the other hand investigated winter dried vegetables should be good source of folic acid (Table 2). They were found as DB µg/g, 214.30-115.30 and 188.84 for dried cauliflower, leek and broccoli respectively. Folic acid can be found in green leafy vegetables so folate term comes from green plants. It is has biological importance in development of fetus during pregnancy and its deficiency cause megaloblastic anemia. RDI of folic acid is 300-400 µg/d, Intake of folic acid during pregnancy is increased as 600 µg/d.

Niacin values of investigated dried vegetables cauliflower, leek and broccoli were DB, mg/100g, 7.1-4.4 and 6.12 respectively. RDI of niacin was 12-16 mg/100g, studied samples can contribute to human nutrition for niacin intake. Animal originated products, mushrooms should be well sources of this vitamin. Niacin is known as "pellagra preventive" PP vitamin, it is the most resistant vitamin against food operations such as heat, light, oxygen. Lack of niacin cause pellagra disease. Thus coenzyme in many biological reduction and oxidation reactions are required for energy metabolism (3, 27).

Mg, Cofactor for enzyme systems, selected source foods are green leafy vegetables, unpolished grains, nuts, meat, their recommended daily intakes (RDI) are Infants 7-12 months; (RDI; 75

mg/d, 1-8 years; 80-130 mg/d, (9-18) years; 240-360 mg/d, for females, 240-420 mg/d for males mg/d, (18- >70) years; 240-420mg/d for males, 240-320 mg/d for female.

Dry vegetables are nutritive from point of Mg quantity (Table 1, 2). The average values in range in dry basis were (mg/100g); 205 and 219.3. But dried eggplant had the highest values of Mg as follows; (mg/100g 2183.5-1868.5).

Calcium, (Ca) is an essential element. These functions have essential role in blood clotting, muscle, contraction, nerve, transmission, and bone and tooth formation. Selected source foods are dairy products and plant sources such as broccoli, Life Stage Groups and their recommended daily intakes (RDI) are Infants 7-12 months; (RDI); 270 mg/d, 1-8 years; 500-800mg/d, 9-18 years; 1300 mg/d, 18-70 years; 1000-1200mg/d. Ca was found in the highest quantity in dried leek as 467 mg/g KM, the other Ca values of winter vegetables were similar as follows: Cauliflower and broccoli mg/100g (226.55-211.85) respectively.

K values all of the dried vegetables were in range (Dry basis, mg/100g); (2745.0-3658.0), (table 1, 2). Dried investigated vegetables should contribute to nutrition because of their sufficient quantity but excessive in take of K is not recommended for chronic renal patients (24, 28).

Main sources of K are fruits and vegetables; dried peas; dairy products; meats, and nuts.

Some of functions of K are maintenance fluid volume inside/outside of cells and thus normal cell function acts to blunt the rise of blood pressure in response to excess sodium intake, and decrease markers of bone turnover and recurrence of kidney. Infants 7-12 months; (RDI); 0.7 g/d, 1-8 years; 3-3.8 g/d, 9-18 years; 4.5-4.7g/d, 18->70 years; 4.5-4.7 g/d.

Potassium from supplements or salt substitutes can result in hyperkalemia and possibly sudden death if excess is consumed by individuals with chronic renal insufficiency (kidney disease) and diabetes. There are special subjects; individuals taking drugs for cardiovascular disease such as ACE inhibitors, potassium sparing diuretics should be careful not to consume supplements containing potassium and may need to consume less than the RDI for potassium.

The Na contents of dried winter vegetables were ideal or optimum quantities for Na/K ratios of these products especially for cardiovascular diseases, found Na/K ratios were as follows (mg/100g DB); 155.95/3658, 240.65/3207 and 169:05/3314.5 dried cauliflower, dried leek, dried broccoli respectively. (Table 2), Na quantities of dried eggplants were in high quantities; 7026.5 and 6153 mg/100g, the reason of high quantity of Na was addition of salt before drying process of eggplants.

Function of Na maintains fluid volume outside of cells and can play important role for cardiovascular system. Source of Na is processed foods which sodium chloride (salt) /benzoate/phosphate have been added to kinds of food products but actually natural vegetables and fruits are the good sources of Na too. Hypertension increased risk of cardiovascular disease and stroke. The RDI for normal people is applied to apparently healthy individuals; it thus may be too high for individuals who already have hypertension or who are under the care of a health care professional.

Recommended daily intakes of Zn: Infants 7-12 months; (RDI); 3mg/d, 1-8 years; 5mg/d, 8-11 mg/d, 9-18 years; 8 mg/d >70 years females; 8 mg/d >70 years males. Zn contents were determined in range of 2.86 and 3.96 DB, mg/100g, (Table 2).

These Zn contents can contribute to human diet. Main sources of Zn are Fortified cereals, red meats, certain seafood. Functions of Zn are Component of multiple enzymes and proteins; involved in the regulation of gene expression. Zinc absorption is lower for those consuming vegetarian diets than for those eating nonvegetarian diets (8, 26, and 27).

Determined Fe contents of dried cauliflower, leek and broccoli; (DB) mg/100g. (in table 2); 14.27, 8.19 and 12.27 respectively. Recommended daily intakes of Fe: Infants: 7-12 months; (RDI); 11 mg/d, 1-8 years; 5mg/d, 7-10 mg/d, 9-18 years; 8 mg/d >70 years females, ; 8 mg/d >70 years males. The Fe quantities of the samples were sufficient for nutrition. Main functions of Fe are component of hemoglobin and numerous enzymes; prevents microcytic hypochromic anemia. Sources of Fe are fruits, vegetables and cereals (nonheme iron sources), meat and poultry (hem iron sources).

In dried eggplants, P contents were found mg/100g

DB were 365.9 and 273.9. Recommended daily intakes of P: Infants: 7-12 months; (RDI); 274 mg/d, 1-8 years; 460-500 mg/d, 9-18 years; 1250 mg/d >70 years females, ; 1250 mg/d >70 years males. The Fe quantities of the samples were sufficient for nutrition. Main functions of P are maintenance of pH, storage and transfer of energy and nucleotide synthesis. Sources are milk, yogurt, ice cream, cheese, peas, meat, eggs, some cereals and breads.

Established values of Cu of eggplants were as follows mg/g DB were 10.98 and 9.5. They are insufficient for daily intake of Cu. Function of Cu is Component of enzymes in iron metabolism. Recommended daily intakes of Cu : Infants: 7-12 months; (RDI); 220 µg/d, 1-8 years; 340-440 µg/d, 9-18 years; 700-890; 900 µg/d; >70 years females, 900 µg/d >70 years males. Main sources are Organ meats, seafood, nuts, seeds, wheat bran, cereals, whole grain products, cocoa (6).

When nutritive values of dried foods were examined, we obtained these results; calorie contents of dried foods were exactly the same but concentrated to smaller quantities as a result of moisture removed, fiber was same. Blanching treatment was applied before drying process, blanching cause the loss of some nutrients. Vitamin A retained under controlled heat methods, on the other hand Vitamin C mostly destroyed during blanching and drying vegetables. Dehydrated vegetables have a unique texture and flavor. These products are preferred to be used as ingredients for soups, casseroles, sauces, stuffing and stew (29).

In the research, obtained results showed that dried vegetables determined nutrients having good quantities except some of nutrients which were given in Table 1, 2 and discussed in detail by comparing literature in the article.

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