Egyptian Journal of Chemistry

http://ejchem.journals.ekb.eg/

Chemical Characteristics, Mineral Contents and Color evaluation of Fresh Garlic Cloves and Dried Garlic Sheet

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Abstract

Garlic, was the rich source of macronutrient and micronutrient content among the vegetables, was dried sheet in an oven dryer to investigate the effect of dried sheet on loss of macronutrient and micronutrient content and other color characteristics and sensory evaluation. The effect of drying on the nutrients and non-nutrients composition of garlic (*Allium sativum L.*) dried sheet was determined. Results indicated that the macronutrient and micronutrient contents were highest in dried sheet compared with fresh garlic gloves samples. All chemical composition (ash, fat, carbohydrates, fiber and protein contents) were increased in dried sheet sample compared to fresh garlic cloves samples, respectively with exception of moisture content. Dried sheet were found to increase energy content compared to fresh samples. Increases of all mineral elements contents upon dried sheet compared to fresh garlic cloves samples were observed. Perhaps, the higher salt concentration gives us the best flavor of the food; it was higher in dried garlic sheet sample 570 µs/cm compared to in fresh garlic cloves sample 340 µs/cm. The changes in non-enzymatic browning (O.D 420nm), a* (redness), C*-values, BI-value and H*-values color values increased in dried garlic sheet while the L* (lightness) and b* (yellowness) value decreased in fresh garlic cloves. In general, it could be concluded that, all dried garlic sheet had the highest score in all sensory parameter, and improved the sensory parameter of garlic dried sheet sample. Also, garlic dried sheet sample may be the preferred method of drying the garlic as it is faster, more hygienic and better preserves the nutrients.

Key Words: garlic, *Allium sativum L.*, dried, sheet, color, salt, mineral, sensory

1.Introduction

Garlic (*Allium sativum L.*) is national to the large plains of Central Asia and was may be transported to Europe by the Mongols. It was used in the past times as a food, spice and for the treated of various disease [1]. It is at most used for the preparation of conventional dishes and products, such as ketchup, salads, stews, mayonnaise, sausages [2], and more lately, it is also rare. Also, it decreases blood triglyceride and total cholesterol level, down arterial pressure, platelet accumulation prevents, prevents cell rising in cancer cells and acts as an antimicrobial factor [3].

Garlic is a plant that is used to a large degree as a component in conventional cooking and furthermore for curative purposes, as it is a lush source of protein and carbohydrates, and also contains great amounts of sulfur-based components [4]. Garlic was applied by the Egyptians in various curative formulas, and by the Romans and Greeks as a recovery factor [5]. Louis Pasteur was the first scientific studies on garlic, which attributed the plant as anti-microbial characteristics [2]. Many studies have showed that extracts of garlic contain antioxidant [6], anti-microorganisms [7] and anti-asthma effects [8], with stream awareness centering on its cancer pre-emptive attributies [9, 10, 11]. Garlic is one of the 600 known species and belongs to the family Alliaceae including shallots, leek and onion [12]. It is in common categorized into two arieties hard neck (ophioscordon) and soft neck (sativum) [13]. Since old times, It has also been used in medicinal science and for cooking purposes. The ancient-known agriculture plants as an whole component of human food. Egyptian feed garlic to pyramid shape to enhance their immunity that way showing safe from different disease and better their behavior [14]. The nutritional structure of garlic showed that it contains, organosulfur compounds, water, protein, free amino acids, fiber and carbohydrates. The consuming of 100 g of garlic gives us 149 kcal. It contains about amount of phosphorous (6 g/kg) potassium (21 g/kg) followed by sodium (532.78 mg/kg) magnesium (1g/kg) iron (52.91 mg/kg) and calcium (363.61

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Receive Date: 24 April 2022, Revise Date: 14 June 2022, Accept Date: 27 June 2022

DOI: 10.21608/EJCHEM.2022.135679.5974

mg/kg). In increment, garlic contains specially thiamin as a vitamin which with high bioavailability due to some certain sulfur containing compounds [15, 16].

Studies on the physical–chemical quality (pH, TSS, acidity, color by tristimulus colorimeter, fructose, glucose and sucrose) of different Spain garlic cultivars were classified into three garlic types (purple, white and Chinese). The sensory evaluation quality (color, odor and pungency intensity by discriminant tests) of the different garlic cultivars, investigating the relation between the different chemical, physical and sensorial parameters evaluated.

The main quality problems notable during drying garlic discoloration, loss of flavour and bad dried characteristics of the dried garlic's. Drying is an industrial preservation method in which water content activity of the vegetables and fruits are reduced by heated air to decreased chemical, microbial and biological deterioration. To obtain high quality of the dehydrated product, the drying process have to be it allows efficient retention of appearance, colour, taste, flavour and nutritive value compared to fresh vegetables. The process of drying is may be the oldest method of food preservation expert by people to increase of food shelf life [17].

Dehydrated garlic is the removal of water from garlic easy transported by a main reduction in bulk, enabling savings in storage area and decreasing the weight. Garlic is dried to mainly produce powder, slices and cubes. The fresh garlic in a stabilized form attempts to mirror the chemical profile of powered garlic. When garlic is peeled, sliced and dried before pulverizing. In dehydrated process where thus garlic cloves are sliced a little allicin is formed, but the allinase and allicin remain separate by many of the cells are unbroken when dehydrated. Dried garlic has very important in home, hotels, restaurants, and in other eating establishments. Also it is used in the flavouring of different products. Studies on the retention of colour and flavour, satisfactory re-hydration characteristics and drying rates during dehydration has been extensively studied. Examination of varieties from the point of view of dehydration has also been carried out [17].

The main quality problems notable during garlic drying weak rehydration properties, loss of flavor and discoloration of the dried garlics. However, garlic colour and flavour are generally showed as quality characteristics [17]. The purpose of the present study was to evaluate the effect of drying on quality changes as chemical composition, mineral contents, color characteristics and sensory evaluations of dried garlic sheet and fresh garlic cloves samples.

2. Material and Methods:

2.1. Plant Material

Egyptian garlic was grown from air bulbils at the Field Experimental in Institute of Agronomy Crops at Agricultural Research Institute, Giza, Egypt. During the growing season, no chemical protection was applied due to the absence of signs of pests and disease. Fresh samples of whole garlic plants, including bulbs, were harvested in May, June, and July (mature plants). The plants were thoroughly cleaned. Samples were stored in a suitable dried room at food technology Lab (NRC, Giza, Egypt). Some of the fresh samples were used to prepare dried garlic sheet, to be analyzed for physical and chemical analysis, as described below. Dried garlic sheets were prepared in duplicate.

2.2. Preparation of dried garlic sheet:

The basic technique for preparing garlic puree is to peel, and then remove the husk from the garlic cloves. The garlic cloves are then pureed if required before drying. Described, ‘cold break method’ of the garlic cloves are first pureed and then blended for 5 minutes, then pureed. Common drying methods used for drying garlic sheet are oven-drying (including convection / fan forced) [18].

The garlic puree was spread into thin layers (1.8 mm) and dried in an air ventilation convection oven at 40 °C for overnight, as seen in flow chart for dried garlic sheet making process (Figure1).

This can be treated by adding suitable additives such as sodium metabisulphite (SO_2) with 0.05% to improve and maintain of gold garlic sheet [19, 20, 21]. Che Man and Sin [22] proposed that extended boiling times can destroy the enzyme that causes enzymatic browning. Chan and Calvetto [23] stated that reducing the sugars involved in the browning process can also be effective in improving the end product.

Flow Chart for dried garlic sheet making process

Garlic cloves
↓
Sorting
↓
Peeling
↓
Mixing by mixer or blender
↓
Blending garlic puree with 0.05% SO_2
↓
Pouring puree onto the trays (with 1.8mm)
↓
Trays transporting to oven cabinet dryer
↓
Drying the puree at 40 ^{o}C for overnight
↓
Removing trays from dryer to get dried garlic sheet

Figure1. Process flow diagram of the dried garlic sheet making process.

Analytical Methods:

2.3. Proximate Analysis:

The proximate analysis was measured in the fresh garlic cloves and dried garlic sheet samples. All chemical parameters were determined using standard methods of analysis [24]. Moisture content was determined using method. No 966.02. The fresh garlic cloves and dried garlic sheet (3-4g) of the different samples in triplicates was weighed and dried in a laboratory oven (Memmert GmbK Schwabach Germany) at 125°C for 2-4 hours. After drying, the samples were placed in desiccators for 30 minutes to cool before being weighed. The moisture content was calculated from weight loss. For nitrogen concentration the Kiejdalh method was used with equipment for digestion and distillation of samples (FOSS Digester and Auto distillation Unit KjeltecTM8200, Tecator Foss, Hillerød, Sweden). The percentage of crude protein was calculated using a factor of 6.25 to obtain the concentration of protein in samples [25]. The crude fat content in fresh garlic cloves and dried garlic sheet was determined by the Soxhlet method using a Soxtec Avanti's 2050 Auto Extraction Unit (Tecator Foss, Hillerød, Sweden). For ash determination of the fresh garlic cloves and dried garlic sheet samples were incinerated in the electric muffle furnace (SNOL 82/110, Utena, Lithuania) at 500°C for 3 hours, until a clear ash was obtained according to A.O.A.C. methods [24]. The total carbohydrate content, in dry matter, was calculated using the following formula:

The amount of total carbohydrates was calculated based on difference using the following formula [25, 26, 27]:

Total carbohydrates (%) = 100 – (moisture (%) + protein content (%) + crude fat (%) + ash (%))…….....(1).

The energy content was calculated. All the calculations were carried out on dry weight basis of the fresh garlic cloves and dried garlic sheet samples.

Mineral Determination:

Calcium, potassium, Sodium, iron, zinc and phosphorus contents of fresh garlic cloves and dried garlic sheet samples were determined in the digested solution according to the method described by Jackson [28]. Mineral content (Ca, K, Na, Fe, Zn and Ph) of fresh garlic cloves and dried garlic sheet samples was determined using a Unicom SP 1900 atomic absorption spectrophotometer (FMD3) according to the method of No 980.03 [29].

Salt determination:

Salt is often measured by electrical conductivity (EC). The most commonly used EC units are deciSiemens per metre (dS/m) and millimho per centimetre (mmho/cm), numerically: 1 dS/m = 1 mmho/cm

Colour determination:

Colour of Egyptian fresh garlic cloves and dried garlic sheet samples was measured using spectro-colourimeter (Tristimulus Colour Machine) with the CIE lab colour scale (International Commission on Illumination) as mentioned by Hunter and Sapers and Douglas, [30,31]. Colour of fresh garlic cloves and dried garlic sheet samples was measured using a HunterLab colourimeter Hunter a*, b* and L*. Parameters were measured with a colour difference meter using a spectro-colourimeter (Tristimulus Colour Machine) with the CIE lab colour scale (Hunter, Lab Scan XE -Reston VA, USA) in the reflection mode. The instrument was standardized each time with white tile of Hunter Lab Colour Standard (LX No.16379): X= 72.26, Y= 81.94 and Z= 88.14 (L*= 92.46; a*= -0.86; b*= -0.16). The instrument (65°/0° geometry, D25 optical sensor, 10° observer) was cali brated using white and black 5382 J. Appl. Sci. Res., 9(8): 5380-5389, 2013 reference tiles. The colour values were expressed as L* (lightness or brightness/ darkness), a* (redness/greenness) and b* (yellowness/blueness). The Hue (H)*, Chroma (C)* and Browning Index (BI) was calculated according to the method of Palou [32] as follows:

H* = tan-1 [b*/a*].....(2)

C* = square root of [a^{2*} + b^{2*}].....(3)

BI = [100 (x-0.31)] 10.72.....(4)

Where:- X = (a*+ 1.75L*) / (5.645L*+ a* - 3.012b*)

Δ E = (Δ a2+ Δ b2 + Δ L2) 1/2 .....(5)

Where: a-a0, b-b0 and L-L0; subscript "0" indicates color of control or untreated sample.

Non-enzymatic browning determination:

Non-enzymatic browning was measured spectrophotometrically in fresh garlic cloves and dried garlic sheet samples by 4054 - UV/Visible spectrophotometer, (LKB-Biochrom Comp., London, England), as absorbance at 420nm using ethanol as blank according to the method of Stamp and Labuza [33] and Birk et al., [34].

Sensory evaluation:

Sensory characteristics (color, odor, taste, texture and overall acceptability) were evaluated by ten staff members of the department of Food Technology, Food Industries and Nutrition Institute, National Research Centre using a numerical scale from 1 – 10 point according to the method of Chang et al., [35].

Statistical analysis:

The obtained results were analyzed statistically using the analysis of variance (ANOVA with two-ways) and the least significant difference (LSD) of $p < 0.05$ as described by Richard and Gouri [36].

3. Results and Discussion

Chemical composition of garlic cloves and dried garlic sheet:

Chemical composition of garlic cloves and dried garlic sheet was analyses with other parameters are showed in table 1. Results showed that garlic cloves contained moisture contents 65.2, crude protein 3.01, crude fat 0.54, crude fiber 1.16, ash 2.28 and carbohydrate (NFE) 27.81%. But results in dried

garlic sheet contained moisture contents 16.14, crude protein 4.85, crude fat 2.66, crude fiber 2.48, ash 5.62 and carbohydrate (NFE) 68.25%, respectively as seen in table (1). The energy content was higher in dried garlic sheet 128.14 k.calories/gm than in fresh garlic gloves 316.34 k.calories/gm, as seen in table (1).

The data regarding moisture contents decreased in dried garlic sheet sample compared with fresh garlic cloves (Table 1). It is evident from the results that there was a gradual decrease in moisture content with increasing concentration of garlic dried sheet. These results correlate with findings of Ahmed et al., Salim-ur-R. et al, and Yusuf et al., [37, 38, 39] who observed a decrease in moisture content in dried garlic sheet. The data on all chemical composition like protein, fat, fiber, ash and carbohydrate showed increased in the dried garlic sheet sample compared with fresh garlic cloves, as seen in table (1). Garlic dried sheet are high in crude protein, crude fat, crude fiber, ash and carbohydrate and their addition resulted in minimum increase in protein and fat contents.

Mineral contents of fresh garlic cloves and dried garlic sheets:-

The amounts of some important mineral elements in fresh garlic cloves and dried garlic sheets are shown in table (2). From the obtained results it could be observed that, the dried garlic sheet had highest of Na, K , Fe, Ca, P and Zn contents while fresh garlic cloves had lowest values for same mineral elements contents.

The highest potassium (K) and sodium (Na) content (119.6 and 8 mg/100gm) was obtained by dried garlic sheet compared with (62.6 and 5 mg/100gm) in fresh garlic cloves, as seen in table (2). According to the present data, mineral profile of garlic cloves showed that it contain phosphorous as a major mineral in a maximum quantity (160.4mg/100g) followed by potassium (62.6mg/100g) calcium (2.5mg/100g) sodium (5mg/100g) zinc (0.266 mg/100g) and iron (0.101mg/100g) respectively. But, mineral profile of dried garlic sheet (table 2) showed that it contains phosphorous as a major mineral in a maximum quantity (270.4mg/100g) followed by potassium (119.6mg /100g) calcium (5mg/100g) sodium (8mg/100g), zinc (0.499mg/100g) and iron (0.271mg /100g) respectively, as seen in Table (2).

It was known that enough iron in a diet is very important for reducing the incidence of anemia. The concentration of iron (Fe) was observed in the fresh garlic (0.101 mg/100gm) and in dried garlic sheet (0.271 mg/100gm) respectively (table 2). Zinc (Zn) is a main and essential metal for the natural function of different enzyme systems. The dried garlic sheet sample had the highest value for zinc content (0.499 mg / 100 gm), while the lowest value (0.266 mg / 100 gm) was obtained in fresh garlic cloves sample (table 2). Also, the dried garlic sheet sample had the highest value for calcium (Ca) and phosphorus (P) content (5 and 270.4mg / 100 gm), while the lowest value (2.5 and 160.4mg / 100 gm) was obtained in fresh garlic cloves sample (table 2).

From the present results it could be observed that, there are a wide variation of mineral content between fresh garlic cloves and dried garlic sheets. But, all produced dried garlic sheets were rich in mineral contents. Extensive research has been carried out to estimate the amount of mineral elements present in garlic samples. The results obtained from the previous findings of Otunola et al., Ujowundu et al. and Yusuf et al., [40, 41, 39] reported that the most abundant amount elements in garlic samples were similar or very close for our results.

Also, Saracoglu et al., [42] showed that, elements as zinc and iron are main and essential elements because they play a role in biological system and are main and essential for natural development and function human cells.

Physico-chemical characteristics of fresh garlic cloves and dried garlic sheet:

The pH, TSS and titratable acidity values of fresh garlic cloves and dried garlic sheet samples were determined and the changes of these values were shown in table (3). As expected, there were differences in pH (6.34 and 5.60) and titratable acidity (0.192-0.432 g/100 g) of fresh garlic cloves and dried garlic sheet samples respectively. The increase in titratable acidity values can be attributed to the drying and concentration of garlic sheet. Total soluble solid (TSS) value was 2% in fresh garlic cloves and increased to 6% in dried garlic sheet, as seen in table (3). Also, increased of TSS can be attributed to the drying and chemical concentration of garlic sheet.

The fresh garlic cloves had slightly higher pH values than those of dried garlic sheet samples, but the total soluble solids (TSS) and total acidity slightly was lower than those of dried garlic sheet samples (Table 3). The pH of dried garlic sheet samples was 5.6, but fresh garlic cloves sample which was 6.34. These results in agreement the results of and Yusuf et al., and Kim et al., [40, 43].

The TSS / acidity ratio is the major analytical measurement for quality in food. The larger ratio leads to the better the flavor of the food [44], it was higher in dried garlic sheet sample (13.889) compared to in fresh garlic cloves sample (10.417). This indicates that dried garlic sheet may be advisable for fresh use. However, it might be processed into acceptable quality dried garlic sheet. Fellers et al., [45] reported that grapefruit juice with TSS/ acidity ratios 7.0 had lower consumer preference scores than juice with TSS / acidity ratios above 11.0. , as seen in table 2.

Salt is mostly instrumentally measured by electrical conductivity (EC). The often commonly used EC units are deciSiemens per metre (dS/m) and millimho per centimetre (mmho/cm), numerically: 1 dS/m = 1 mmho/cm.

Table (1): Proximate composition (%) of fresh garlic cloves and dried garlic sheet.

Nutrients	Fresh Garlic cloves (%)	Dried Garlic sheet (%)
Moisture content	65.2	16.14
crude Protein	3.01	4.85
crude Fat	0.54	2.66
Ash	2.28	5.62
crude Fiber	1.16	2.48
Carbohydrate**	27.81	68.25
Energy content (K.Calories/gm)*	128.14	316.34

* The formula is Energy (in Kcal) = 4x (Proteins and carbohydrates mass in grams) + 9 x mass of fat in grams.
carbohydrate calculated by difference.**

Table (2): Mineral composition of fresh garlic cloves and dried garlic sheet.

Mineral elements	Fresh Garlic cloves (mg/100gm)	Dried Garlic sheet (mg/100gm)
Calcium (Ca)	2.50	5.00
Potassium (K)	62.60	119.60
Sodium (Na)	5.00	8.00
Iron (Fe)	0.101	0.271
Zinc (Zn)	0.266	0.499
Phosphorus (P)	160.40	270.40

Table (3): Percentage composition of phytochemicals in fresh garlic cloves and dried garlic sheet.

Physical properties	Fresh Garlic cloves	Dried Garlic sheet
pH	6.34	5.60
TSS	2	6
Titratable acidity (as citric acid)	0.192	0.432
TSS : T. acidity ratio	10.417	13.889
Salt Micro siment /cm (µs/cm)	340	570

There is big relation between TSS and EC. A general relation has mostly been applied to determine TSS from EC i.e., TSS (mg/l) = ECe x 640.

EC is instrumentally measured in units called Seimens per unit area (e.g. mS/cm, or miliSeimens per centimeter), and the higher the dissolved any material in a water sample, the higher the EC will be in that material.

Sodium chloride (NaCl) as a salt as was instrumentally measured with electrical conductivity (EC) as a Micro siment /cm (µs/cm) unit. Perhaps, the higher salt concentration gives us the best flavor of the food, it was higher in dried garlic sheet sample 570 Micro seiment /cm (µs/cm) compared to in fresh garlic cloves sample 340 Micro siment /cm (µs/cm), as seen in table 3. Also, increased of salt concentration can be lead to the chemical concentration and drying of garlic sheet.

Color characteristics and non-enzymatic browning of garlic cloves and dried garlic sheet:

An important attribute for quality assessment is the product colour. The colour parameters (a*, b*, L*-values) of the dried garlic sheets were effect by the drying method, as seen in Table (4). In comparison to the fresh garlic cloves, reduce in the L* value was showed in dried garlic sheet. The L* value of the dried garlic samples was lower than those of fresh garlic cloves sample. An increase in a* values was showed in the dried garlic sheets compared to the fresh samples. We observed that a* value increased with increasing drying temperature for the convective (40 ºC) dried garlic sheet samples. The changes in L* and a* values in dried garlic sheets was follow similar trends, but there were some variations within the b* values for dried garlic sheet samples. The b* value of the dried garlic sheets generally was lower than that of fresh samples. A good way to know the colour intensity was compared to fresh sample, the C*, H* and BI values of the dried garlic sheets samples were increased. An increasing was showed in the C*, H* and BI values of the dried garlic sheets samples when looked at in relation to the fresh samples, which obvoiusly indicates that more browning occurred. Also, the non-enzymatic browning (OD420nm) was higher in the dried garlic sheets compared to the fresh garlic cloves samples, as showed in table (4). This is perhaps due to the higher a* values of the dried garlic sheets samples. Compared with the dried garlic sheets samples, the better colour values were obtained from the fresh sample. Colour changes of the dried garlic sheets caused by the formation of brown pigments by non-enzymatic reactions (Maillard reaction) and enzymatic reactions and drying treatment may be strongly related to pigment degradation, especially the degradation of carotenoids [46, 47].

The L*, a*, b*, C* and H* color values were used to follow the differences in color of fresh garlic cloves and dried garlic sheet samples (table 4). Changes in L*, a*, b*, C* and H* -values were seen for the dried sheet samples. This was due to different moisture

contents of fresh and dried garlic sheet samples (table 1). This results was in agreement with the study of Özkan et al. and Meltem et al. [48, 49] who founds that as the moisture content of dried apricot increased, the C*-values, H*-values and a* (redness) color values increased while the L* (lightness) and b* (yellowness) values decreased. Although they found that the color of dried apricot samples cannot be differentiated by the reflectance spectrophotometer, the color differences were apparent visually.

Sensory evaluation of fresh garlic cloves and dried garlic sheet samples:

Sensory characteristics of produced dried garlic sheets (color, taste, odor, texture and overall acceptability) were evaluated after direct processing compared with fresh garlic cloves. Table 5 gives sensory evaluation values of fresh garlic cloves and dried garlic sheet sample. The minimum sensory values for fresh garlic cloves sample was 8.4a for color, 6.8b for texture, 6.8b for taste, 8.2b for odour and 7.2b for overall acceptability whereas the maximum sensory values for dried garlic sheet sample was 8.6a for color, 8.8a for texture, 8.6a for taste, 9.6a for odour and 9.4a for overall acceptability (Table 5). The mean sensory evaluation for dried garlic sheet samples was highest for color, taste, odour and texture than for fresh garlic cloves (Table 5). The overall acceptability values of 9.4a indicates that the product of dried garlic sheet was liked moderately by the panel than fresh garlic cloves, as seen in Table 5. Also, LSD as statistical analysis were N.S., 1.172, 0.886, 0.594 and 0.443 for color, odour, taste, texture and overall acceptability values, respectively as seen in table 5.

On the other hand, dried garlic sheet had the highest score in all sensory parameter, and improved the sensory parameter of garlic sheet. Moreover, there was difference between dried garlic sheets and fresh garlic cloves in all sensory characteristics. In general, it could be concluded that, all dried garlic sheet samples were accepted by the ten panelists. However, differences in all sensory characteristics where observed between fresh garlic cloves and dried garlic sheet in all studied samples.

Sensory evaluation of the dried garlic sheets is considered as one of the important factors that affect, to a large extent, their acceptability for consumer. Therefore, the prepared dried sheet samples were evaluated organoleptically by ten panelists immediately after drying process for colour, odour, taste, texture and overall acceptability and then statistically analyzed and the results are shown in Table (5), it could be noticed that the dried sheet samples of garlic had higher scores than fresh garlic cloves.

Table (4): Color characteristics and non-enzymatic browning in fresh garlic cloves and dried garlic sheet.

Nutrients	Fresh Garlic cloves	Dried Garlic sheet
L*-vale	82.913	41.706
a*-value	3.583	18.61
b*-value	29.393	26.173
C*-value	29.611	32.115
H*-value	6.937	40.743
BI-value	52.055	184.819
Non-enzymatic browning (O.D 420nm)	1.046	9.926

Table (5): Sensory evaluation of fresh garlic cloves and dried garlic sheet.

Samples	Color	Odor	Taste	Texture	Overall acceptability
Fresh garlic Cloves	8.4^{a}	8.2^{b}	6.8^{b}	6.8^{b}	7.2^{b}
Dried garlic Sheet	8.6^{a}	9.6^{a}	8.6^{a}	8.8^{a}	9.4^{a}
LSD	N.S.	1.172	0.886	0.594	0.443

Conclusions

The current studies shows that the preparation of dried garlic sheet can be scaled up to small scale level and can be used as a quality and nutritional food adjunct. The product has considerable amount of carbohydrate, crude fibers and other minerals. It can be easily prepared by using wild garlic pulp and drying the mixture in a mechanical dehydrator and thus the recipe was optimized. The data on all chemical composition like protein, fat, fiber, ash and carbohydrate showed increased in the dried garlic sheet sample compared with fresh garlic cloves. The fresh garlic cloves had a little higher pH values than of dried garlic sheet samples, but TSS and total acidity a little was lower than of dried garlic sheet samples. The larger salt concentration leads to the better the flavor of the food, it was higher in dried garlic sheet sample 570 Micro seiment /cm (µs/cm) compared to in fresh garlic cloves sample 340 Micro siment /cm (µs/cm). But, all produced dried garlic sheets were rich in mineral contents. The changes in non-enzymatic browning (O.D 420nm), a* (redness), C*-values, BI-value and H*-values color values increased in dried garlic sheet while the L* (lightness) and b* (yellowness) value decreased in fresh garlic cloves. In general, it could be concluded that, all dried garlic sheet had the highest score in all sensory parameter, and improved the sensory parameter of garlic sheet. Therefore, the prepared

dried sheet samples were evaluated organoleptically for colour, odour, taste, texture and overall acceptability and then statistically analyzed and the results that the dried sheet samples of garlic had higher scores than fresh garlic clove**s.**

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