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EFFECT OF DRYING PROCESS ON NUTRITIONAL VALUE, CHEMICAL, PHYSICAL AND SENSORY PROPERTIES FOR ONION

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ABSTRACT

Drying onions from the food industry economically important, because it reduces transportation costs, and the microbial spoilage, as well as storage space, also lead to the distribution of the crop throughout the year, in addition to price stability.

The aim of this study is to examine the effect of the drying process on the chemical, physical and sensory properties for onion slices. The results obtained showed that the increase in temperature led to a reduction in moisture content and increasing the dry material components. Also decreased the level of amino acids with increasing temperature due to its interaction with the free sugars composed brown color (Miller reaction). As shown by the study of the sensory properties that sun dried onion and dried in the oven at 40 °C was more acceptable than onion powder 50 °C. Also found that the color of the onion growing darker with increasing temperature, while the total phenolic compounds increased with drying due to reduced moisture content, especially among fresh onions and sun dried onion and dried in the oven at 40 and 50 °C, where it was 27, 520, 581 and 596 mg/100, respectively. Based on these results, we recommend drying onions slices by the sun or dryers at a temperature not exceeding 50 degrees Celsius so as not to be affected its chemical, physical, sensory properties and nutritional value.

INTRODUCTION

Onion (*Allium cepa*) has been widely used even in ancient times as seasonings, foods and for medical uses. In current times, onion is an important vegetable to serve as ingredients in dishes, as toppings on burgers, in seasonings, as chip coatings etc (Sharma *et al.,* 2005).

Onion finds widespread usage in both fresh and dried forms. Dried onions are a product of considerable importance in world trade and are made in several forms: flaked, minced, chopped and powdered. It is used as flavor additives in a wide variety of food formulations such as comminuted meats, sauces, soups, salad dressings and pickle relishes (Kumar *et al.,* 2006).

Although the influence of hot air drying on food quality is well recognized the understanding of processes caused by dewatering and adversely affecting material properties is limited. The major challenge during drying of food materials is to reduce the moisture content of the material to the desired level without substantial loss of flavor, taste, colour and nutrients. Beside the adverse influence of drying on food quality the process is indispensable in many food industry sectors because of the increased shelf-life of the product, reduced packaging cost, lower shipping weights and environmental advantages. Moreover, drying used properly can result in unique properties not achievable by other technological procedures. Today's consumer expectation for better quality, safety and nutritional value drives research and improvement of drying technologies. One of the most important ways to reduce the adverse influence of drying on food quality or to ensure basic quality properties of the final product is to carefully design the process and implement it consistently (Lewicki, 2006).

The colour and flavor of the dried onion are considered the most important quality attributes affecting the degree of acceptability of the product by the consumer. The non-enzymatic browning reaction, measured by optical index, and loss in pungency, measured by thiolsulphinate or pyruvate concentration, are considered as dominant factors in quality deterioration during drying and storage of dried onion (Pezzutti and Crapiste, 1997; Schwimmer, 1981).

Onions contain high levels of non-nutrient antioxidant compounds (flavonoids) with protective effects against different degenerative pathologies Griffiths, *et al*., (2002). Flavonols and anthocyanins are the main subclasses of flavonoids present in onions, the latter being found especially in red onions. White, yellow or red onions are known to contain large amounts of flavonols, mainly quercetin, conjugated with sugars as glucose. Onions are recognized as themajor dietary source of quercetin as aglycone or O-glycosylated derivatives (Hertog *et al.,* 1992).

The objective of this study was to determine an effect of drying process on nutritional value and the chemical, physical, sensory properties for onion slices undergoing sun and oven drying. The information obtained could be helpful to design the appropriate drying process to minimize the quality degradation.

MATERIALS AND METHODS

Materials:

Fresh onions (*Allium cepa*) were procured from a local market in Kafr El-Sheikh City, Egypt. The onions were hand peeled, cut into slices of approximately 10.0 - 0.1 mm thickness with a sharp stainless steel knife in the direction perpendicular to the vertical axis. All the chemicals were from purchased from El-Nasr Company for Drugs Trading and Chemicals.

Methods:

Drying of the onion slices:

Sun drying:

100 g of onion slices were distributed uniformly as a thin layer onto the stainless steel trays of size 0.3 - 0.2 m and dried under direct sunlight at temperatures between 30 and 35 °C in August in Kafr El-Sheikh City, Egypt.

Oven drying:

100 g of onion slices were distributed uniformly as a thin layer onto the stainless steel trays of size 0.3 - 0.2 m and dried in an oven (FN055 USA, 55 L volume) at 40 and 50 °C (Balladin and Headley, 1999).

The mass of the sample was measured in every 1 h during oven and sun drying process (Günhan *et al.,* 2005; Maskan *et al.,* 2002) using a digital balance, measuring to an accuracy of 0.001 g (Gikuru and Olwal, 2005). A tray with the sample was taken out of the drying chamber, weighed on the digital balance and placed back into the chamber. The digital balance was kept very close to the drying unit and the weight measurement process took about 10 s time (Sharma *et al*., 2005). Experiments were repeated three times and mean values were used.

The initial moisture content of the slices was measured by drying in an oven at 105 °C for 24 h and expressed as kg water/kg dry solids which varied between 9.00 and 9.04 kg water/kg dry solids and corresponds to 89.8 g water/100 g fresh onion (AOAC, 1990). The equilibrium moisture content was 0.85, 0.58 and 0.01 (dry weight basis) for sun drying, oven drying at 40 °C and oven drying at 50 °C, respectively.

Determination of Proximate composition:

The recommended methods of the Association of Official Analytical Chemists (AOAC, 1990) were adopted to determine the levels of crude protein, moisture, ash and oil. Nitrogen content was determined by using the Kjeldahl method (Kjeldahl, 1883) and multiplied by a factor of 6.25 to determine the crude protein content. The moisture content was determined by drying the samples, at 105 °C, to a constant weight. Crude fat was determined by the Soxhlet method. Crude fat was obtained by exhaustively extracting 5.0 g of each sample in a Soxhlet apparatus using petroleum ether (boiling point range 40 – 60 °C) as the extractant. Total carbohydrate content was obtained by difference.

Free amino acid analysis:

Free amino acid samples were prepared for HPLC analysis by flour (1 g) extraction with 0.1 M HCl (about 10 ml), then filtered by 0.45 lm filter (Millipore Millex-HV). One millilitre was applied to a cation exchange (100 x 6 mm) column [AG 50W-X8(H^+), Bio-Rad]. After the column was washed with 50 ml of milli-Q Water, the amino acids were eluted with 3.0 M NH3 (about 10 ml). The sample was evaporated and recovered with 0.01 M HCl (9.2 ml) and internal standard (BABA 2.5 mM in 100 ml 0.1 M HCl) (Strydom and Cohen, 1994).

Sensory evaluation:

Sensory evaluation data were analyzed statistically and relative frequency distributions (RFD) were calculated for each sample and quality attribute. These data are summarized and presented in Table 3. In either case, high RFD values would mean higher percentage of panel members designated the particular grade for either of the quality factor being evaluated (color, texture, and flavor). On the other hand low RFD would mean the opposite.

Colour measurement:

Colour of onion slices was measured by Minolta Chroma meter CR 400 colour meter (Minolta Co., Osaka, Japan) before and after drying. The colour meter was calibrated against a standard calibration plate of a white surface and set to CIE Standard Illuminant C. The L*, a*, b* values are average of ten readings. The colour brightness coordinate L* measures the whiteness value of a colour and ranges from black at 0 to white at 100. The chromaticity coordinate a* measures red when positive and green when negative, and chromaticity coordinate b* measures yellow when positive and blue when negative (Doymaz *et al*., 2006).

Total phenolic:

Total phenolic were analyzed spectrophotometrically (Shimadzu UVevis mini spectrophotometer 1240) using the Folin-Ciocalteu colorimetric method (Singleton *et al.,* 1999).

Statistics:

Triplicate analyses for each measurement were conducted for each sample. To establish the reproducibility of the analytical method, sample preparation was repeated three times. Differences between the means were evaluated with ANOVA, using the Graf Pad Instat 3 (Microsoft Software) statistics program. The significance of the model was evaluated by ANOVA. The significance of the regression coefficients was evaluated by the Student's T test. The significance level was fixed at 0.05 for all the statistical analyses.

RESULTS AND DISCUSSION

Proximate chemical composition:

The proximate composition of fresh and dried onion were shown in Table 1. Noted that the moisture was decreased with increasing the drying temperature where was 90.04, 14.55, 13.10 and 12.03% for fresh, solar drying, oven drying at 40 and 50 °C, respectively. In contrast, increased other remaining ingredients with increasing drying temperature. These results due to loss of moisture by evaporation during drying, which leads to increase in other remaining ingredients. These results are agreement with (Yahya *et al*., 2000 and Mota *et al*., 2010).

Table (1) : Proximate chemical composition of fresh and dried onion under various temperatures

Compound	fresh	Solar drying	Oven (40 C°)	Oven (50 C°)
Moisture (% wet basis)	90.04 (±0.33)	14.55 (±0.34)	13.10 (±0.64)	12.03 (±0.50)
Ash (g/100 g dry solids)	1.40 (±0.20)	4.99 (±0.20)	5.24 (±0.25)	6.00 (±0.84)
Fat (g/100 g dry solids)	0.20 (±0.02)	0.35 (±0.04)	0.25 (±0.01)	0.38 (±0.06)
Crude protein (g/100 g dry solids)	0.26 (±0.01)	0.49 (±0.05)	0.52 (±0.01)	0.57 (±0.07)
Carbohydrates (g/100 g dry solids)	8.10 (±0.46)	79.62 (±0.72)	80.89 (±0.52)	81.02 (±0.64)

Values are the mean ± SD of three different determinations ($p < 0.05$).

Free amino acid analysis:

Table 2 shows the free amino acids present in fresh and dried onion under various temperatures. In particular, these revealed large amounts of glutamic acid (299.0 mg/100 g), arginine (250.0 mg/100 g) and aspartic acid (101.0 mg/100g) along with lesser amounts of methionine (16.0 mg/100 g) and tryptophan (27.4 mg/100 g) in fresh onion. Observed that an increase in drying temperature led to a clear reduction in many of the amino acids, especially methionine 16.0, 11.4, 9.6 and 8.3 (mg /100 g) and cysteine 34.4, 26.8, 24.4 and 21.3 (mg /100 g) for fresh, solar drying, oven drying at 40 °C and 50 °C, respectively.

Table (2): Free amino acid analysis of fresh and dried onion under various temperatures (mg /100 g).

Amino acid	fresh	Solar drying	Oven (40 C°)	Oven (50 C°)
Tryptophan	27.4 (±0.4)	26.7 (±0.5)	27.6 (±0.6)	26.2 (±0.3)
Threonine	45.6 (±0.1)	45.1 (±0.2)	44.8 (±0.4)	45.3 (±0.3)
Isoleucine	66.4 (±0.3)	66.1 (±0.4)	65.8 (±0.1)	63.0 (±0.7)
Lucien	66.0 (±0.6)	65.7 (±0.2)	64.3 (±0.1)	62.8 (±0.3)
Lysine	88.4 (±0.4)	88.3 (±0.1)	87.5 (±0.4)	85.3 (±0.5)
Methionine	16.0 (±0.5)	11.4 (±0.5)	9.6 (±0.7)	8.3 (±0.2)
Cysteine	34.4 (±0.1)	26.8 (±0.1)	24.4 (±03)	21.3 (±0.4)
Phenylalanine	48.0 (±0.2)	47.5 (±0.8)	46 2 (±0.4)	45.4 (±0.7)
Tyrosine	46.4 (±0.4)	46.7(±0.4)	46.0 (±0.2)	45.3 (±0.3)
Valine	43.6 (±0.8)	42.5 (±0.6)	43.9 (±0.3)	44.1 (±0.5)
Arginine	250.0 (±3.1)	245.2 (±4.4)	241.2 (±3.6)	240.4 (±2.9)
Histidine	30.4 (±0.4)	29.2 (±0.6)	26.3 (±0.6)	25.5 (±0.3)
Alanine	51.6 (±0.3)	50.4 (±0.7)	50.0 (±0.7)	48.7 (±0.8)
Aspartic acid	101.0 (±1.7)	100.0 (±0.3)	99.9 (±1.1)	98.5 (±2.3)
Glutamic acid	299.0 (±2.6)	289.6 (±2.4)	279.0 (±3.8)	280.9 (±3.4)
Glycine	77.0 (±0.6)	76.2 (±0.8)	74.5 (±0.6)	74.9 (±0.9)
Proline	58.2 (±0.5)	57.6 (±0.6)	26.5 (±0.7)	25.9 (±0.4)
Serine	54.6 (±0.4)	54.0 (±0.2)	52.1 (±0.3)	51.6 (±0.8)
Hydroxyproline	-	-	-	-

Values are the mean ± SD of three different determinations ($p < 0.05$).

These results are due to the effect of temperature on the sulfur group in these acids as well as the interaction between amino acids and simple sugars in onions (interaction Miller). These results are similar to the results obtained by (Nishimura and Kato, 1988).

Sensory evaluation:

Table 3 shows the sensory evaluation data obtained for onion samples indicate that both the solar drying and oven drying at 40 °C were approximately similar. Where, dried samples gained good acceptance for all quality attributes (color, texture and flavor) while solar and oven dried at 40 °C were highly accepted in the case of color by 36.5% of the panelists and well accepted in the cases of texture and flavor by 33% and 36% of the panel members respectively.

Table (3): Sensory evaluation data of fresh and dried onion under various temperatures

Sample	Relative frequency distribution (scour 12)			Sensory evaluation
	Color	Texture	Flavor	
Solar drying	9	9	11	Good acceptance
Oven (40 C°)	10	10	10	Good acceptance
Oven (50 C°)	8	11	8	Medium acceptance

On the other hand, oven drying at 50 °C drying was tested, data indicate that all samples maintained their medium acceptance by the panel members for both color and flavor, and medium acceptance in the case of texture. These results are consistent with the results of (Yahya *et al.,* 2000).

Colour assessment:

Drying methods and temperatures exert a significant effect on the colour changes of onion slices. Product colour is the other quality parameter that needs to be maintained during onion drying. Table 4 shows the colour data in terms of Hunter L*, a*, b* values of fresh and dried onion slices. L* values of onion slices decreased by drying. L* values of sun dried samples was the highest among the other dried samples which were closer to the L* values of fresh sample ($P < 0.05$). Oven dried at (40 °C) and (50 °C) sample had the lowest L* value.

Table (4): Color assessment of different drying methods on L *, a * and b * values of onion slices.

Sample	L *	a *	b *
Fresh	62	-1.2	5.4
Solar drying	56	0.4	14.3
Oven (40 C°)	43	0.5	13.8
Oven (50 C°)	45	0.6	12.3

Oven dried onion slices were significantly darker in colour when compared to sun samples. This may be due to the high temperature and long drying time (Sumnu, *et al*., 2005). Higher L* values are desirable in the dried products (Doymaz *et al.,* 2006).

Phenolic compounds content:

Table 5 shows the average total phenol content of fresh and dried onion slices. The phenolic concentrations of the dried onion slices were higher than the concentration of fresh sample (27 mg/100 g) due to the moisture loss. There was not a significant difference between the phenolic contents of sun (520 mg/100 g) and oven (40 °C) (581 mg/100 g) dried samples. These samples had lower values than the sample dried at 50 °C in the oven (596 mg/100 g). It is also noted that the large drying period for which the product is exposed to the atmospheric oxygen has an adverse effect on some quality aspects like reduction in ascorbic acid, etc. (Sarsavadia, 2007). The increase in total phenolics is possibly due to the liberation of phenolic compounds from the matrix during the drying process. Drying might have accelerated the release of bound phenolic compounds during the breakdown of cellular constituents (Chang *et al*., 2006; Chism and Haard, 1996).

Table (5): Effects of different drying methods on total phenolic compounds contents of onion slices.

Sample	Total phenol (mg/100g)
Fresh	27 (±0.2)
Solar drying	520 (±3.2)
Oven (40 C°)	581 (±2.6)
Oven (50 C°)	596 (±3.5)

Values are the mean ± SD of three different determinations ($p < 0.05$).

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تـأثير عمليـة التجفيـف علـى القيمـة الغذائيـة والخصـائص الكيميائيـة والفيزيائيـة والحسية للبصل.

السيد عوض شعبان عبد الرسول و أمانى عبد الرحمن على متولى
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تجفيف البصل من الصناعات الغذائية الهامة اقتصاديا, لأنها تقلل من نفقات النقل, و التلف الميكروبي, وكذلك مساحة التخزين, كما تؤدى إلى إمكانية إستهلاك المحصول على مدار العام, بالإضافة لثبات الأسعار.
الهدف من هذه الدراسة هو دراسة تأثير عملية التجفيف على الخصائص الكيميائية والفيزيائية والحسية لشرائح البصل. وأوضحت النتائج المتحصل عليها ان زيادة درجة الحرارة أدت إلى خفض المحتوى الرطوبى وزيادة مكونات المادة الجافة. كذلك إنخفض مستوى الأحماض الأمينية بزيادة درجة الحرارة بسبب تفاعلها مع السكريات الحرة مكونة اللون البنى أو ما يعرف بتفاعل ميلر. كما تبين من دراسة الخواص الحسية ان البصل المجفف شمسياً و المجفف بالفرن على درجة ٤٠°م كان أكثر قبولاً من البصل المجفف على درجة ٥٠°م. تبين أيضاً أن لون البصل يزداد قتامة بزيادة درجة الحرارة, بينما إزدادت المركبات الفينولية الكلية مع التجفيف بسبب خفض المحتوى الرطوبى خصوصاً فى البصل الطازج و البصل المجفف شمسيا و المجفف بالفرن على درجة ٤٠ و ٥٠ °م، حيث كانت ٢٧ و ٥٢٠ و ٥٨١ و ٥٩٦ ملجم/١٠٠جم على التوالى. وبناء على هذه النتائج نوصى بتجفيف شرائح البصل بواسطة الشمس او المجففات على درجة حرارة لا تزيد عن ٥٠ درجة مؤية حتى لا تتأثر خواصه الكيماوية والفزيائية والحسية.

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