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Dehydration of Osmosised Red Bell Pepper (*Capsicum annum)*

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Abstract: Perishability is still a major problem leading to scarcity of vegetables during dry season in Nigeria. Preserving them by dehydration is a cheap solution. This study therefore investigated the effect of drying on the chemical composition of osmosised and dehydrated red bell pepper *Capsicum annum* (Tatase) with the intent of producing dry pepper with high chemical compositions. Sugar and distilled water were used to prepare osmotic solution (60°Brix) inside which the red bell pepper were dipped at 40°C for 9 h at 30 min interval for the first two hours (30, 60, 90, 120 mins.) and at 1 hour interval for the remaining seven hours (180, 240, 300, 360, 420, 480 mins.), respectively. The osmosised sample was finally subjected to freeze drying, oven drying and solar drying. After drying, the proximate composition, vitamin C content and Water Absorption Capacity (WAC) of the samples were analyzed. The result of the proximate composition showed that the osmosised raw pepper contained 15.47% protein, 8.93% Ash, 11.60% fat, 0.22% crude fibre and 63.37% carbohydrate; freeze dried sample contained, 15.30% protein, 8.77% Ash, 11.52% fat, 0.16% crude fibre and 64.25% carbohydrate; solar dried sample contained 15.28% protein, 8.70 Ash, 11.58% fat, 0.20% crude fibre and 64.32% carbohydrate while oven dried sample contained 12.27% protein, 8.35% Ash, 11.38% fat, 0.21% crude fibre and 67.79% carbohydrate in comparison with the raw sample (without treatment) which contained 27.27% protein, 10.79% Ash, 15.78% fat, 0.67% crude fibre and 45.49% carbohydrate. The vitamin C and Water Absorption Capacity contents were; 150 mg/100 g and 100%v/w, 125 mg/100 g and 350% v/w, 100 mg/100 g and 250% v/w, 125 mg/100 g and 300%v/w and 200 mg/100 g and 50%v/w for osmosised raw, freeze dried, solar dried, oven dried and raw pepper samples, respectively. These results indicated that freeze drying method was the best method that resulted in less reduction of protein and vitamin C content of the pepper after drying and had the highest water absorption capacity.

Key words: Osmosis, freeze drying, oven drying, solar drying, analyses

INTRODUCTION

Pepper is an important aspect of the diet and are widely consumed in almost every part of Nigeria, mostly in Western part where it is believed that it make one to be strong and healthy[1]. It is either eaten raw, cooked or used commonly in making paste; pickles and sauce. It is also used as a spice and flavour ingredient in the food industries[2].

Peppers are gaining popularity in homes not only for the uniqueness but also because they are low in sodium; cholesterol free; low in calories, exhibits additive qualities, helps to prevent stomach ulcers by killing bacteria one may have ingested. It also stimulates the cells lining the stomach to secrete protective buffering juices. It contains a wide range of phytochemicals It is also high in vitamins A and C, which are important anti-oxidants and part of today's healthy lifestyles: Vitamin C is hypothesized to prevent cancer by inhibiting the formation of N-nitroso compound in stomach and also by stimulating the immune system[3].

There are many cultivars of pepper that may be classified as sweet; mild or hot depending on the amount of capsaicin ($CH_3OC_{17}H_{24}NO_2H$) present, the compound that exhibit the additive qualities, a complex of amides that are incredibly pungent. Capsaicin is a potent chemical that can survive both cooking and freezing but apart from burning sensation; it also triggers the brain to provide endorphins, natural pain-killer that promotes a sense of well being. Peppers have a wide range of pungency which is affected by the environment in which they were grown[4,5]. Nutritional composition of red-bell pepper (*Capsicum annum*) are shown in Table 1.

However, they are usually in short supply during dry season because they are perishable crops which deteriorate within a few days after harvest (which occur

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Table 1: Nutritional composition of red-bell pepper

Nutritional	Composition
Moisture	74%
Food energy	9.4 calories
Protein	4.1 g
Fat	2.3 g
Calcium	58 mg
Iron	2.9 mg
Thiamine	0.25 mg
Riboflavin	0.20 mg
Niacin	2.4 mg
Ascorbic acid	121mg

Source: Ngoddy and Ihekoronye[1]

mainly in the rainy season). Preserving these crops in their fresh state for months has been problem that is yet to be solved Tunde Akintunde *et al.*,[6].

Pepper have very high moisture content which increases the rate of microbial action in them which make pepper to be readily subjected to deterioration and post-harvest losses. One of the ways of eliminating the microbial actions in pepper due to their high moisture content is by drying to a safe moisture level that will not permit microbial action in order to conserve the perishable fruits; reduce storage volume, decrease transportation cost and extend the shelf-life beyond few weeks when they are in seasons[6].

Pretreatment excluding the use of chemical may have great potential in food processing. Ade-Omowaye[7]. The nutrient most susceptible to destruction in food dehydration are vitamins A and C which are very sensitive to heat. Changes that occur to sensory characteristics include the loss of fresh flavour; poor texture resulting from shrinkage of the food. Meanwhile, the quality defects attributed to enzyme actions are off-odour; and off-flavour Anna Kuzniar[8]. One of the more energy efficient means of removing moisture from a food piece and having the food qualities preserved is by osmosis, since water does not have to go through a phase change[9-12].

Osmotic dehydration techniques not only enable the storage of the fruit for a longer period or reduce the air drying time but also offer advantages such as: to improve the product quality; retention of vitamins; flavour enhancement and colour stabilization without sulphite addition[7,10].

Traditionally, pepper are dried in the open air and exposed to the sunlight which usually takes 3-6 days. According to Ibrahim and Mehmet[2] this practice is a common method, yet it has several drawbacks such as time consuming; prone to contamination with dust; soil; sand-particles; birds and insects and being weather dependent. This study therefore investigated some drying methods after osmotic pretreatment with a view to obtaining and recommending an appropriate drying method to produce dried red bell pepper of high chemical qualities.

MATERIALS AND METHODS

Red bell pepper and sugar were purchased at main market, Akure and distilled water from Chemistry Laboratory, Department of Chemistry, FUTA.

Osmotic dehydration of pepper: The pepper was washed and cleaned in water to remove adhering gum; soil; to reduce microbial load etc. and the stalk was removed; then bolted with tissue paper and weighed. Osmotic solution of 60° Brix concentration was prepared using the Eq. below:

$$x/x + y = z\%$$

where

x = weight of solute i.e. sugar
y = weight of solvent i.e. distilled water
z = % of the weight/weight °Brix.

The peppers were immersed in a beaker containing 60°Brix osmotic sucrose solution. The temperature of the sugar solution was maintained at 40°C using a thermometer in a water bath. The pepper weighed prior to immersion were removed from the osmotic solution at the end of 30, 60, 90, 120, 180, 240, 300, 360, 420, 480 and 540 minutes with their surface gently blotted dry with tissue paper and weighed[13].

Oven dried sample: The oven was set at a temperature of 100°C to warm up for about 10 min. The osmosised sample weighed 8.843, 9.125, 8.694 and 9.789 g was put in an oven at a temperature of 50°C until constant weight were recorded[7]. After drying, the sample was removed, placed in desiccator to cool and re-weighed then sealed in a stomacher nylon for storage.

Solar dried sample: The sample used for this method was weighed and placed in a solar dryer at A.G.E department, FUTA for 5 days when constant weight has been achieved, the sample was sealed for storage.

Freeze dried sample: 10 g was first frozen for about 2 h. The frozen pepper was dried by keeping it in a vacuum chamber at a pressure of 2 mm/Hg and at a temperature below melting point of ice. After drying to a constant weight, the vacuum was broken with inert nitrogen gas and the sample cooled in desiccator and sealed for storage.

Analysis of the samples: Chemical analysis as well as Vitamin C and Water Absorption Capacity (WAC) determination were carried out on the samples.

Chemical analysis: This involved the determination of the proximate composition on each sample based on the standard.

Water Absorption Capacity (WAC) determination: Water absorption capacity was determined using the method of Sathe[14].

Vitamin C determination: Vitamin C content was determined using titration method.

RESULTS AND DISCUSSION

Table 2 shows the proximate composition on dry basis of fresh red bell pepper, osmostically dehydrated both before drying and after subjecting it to various types of drying methods. The protein content of the raw sample before subjecting to osmotic dehydration (27.27%) is greater than the protein content of the osmotically dehydrated red-bell pepper. The protein content of the raw sample was 27.22% while raw sample subjected to osmotic dehydration was 15.47%. This implies that osmotic dehydration might have resulted in the leaching of some soluble protein into the osmotic solution. From Table 2, the protein content of the red bell pepper subjected to osmotic dehydration followed by various drying methods show that there exist a significant difference $p \leq 0.05$ in the protein content of the red bell pepper subjected to various drying method except between freeze dried sample (15.30%) and solar dried sample (15.28%). The freeze dried sample has a protein content of 15.30% which is significantly different from the raw sample (27.27%). The solar dried sample has a protein content of 15.28% while the oven dried sample has a protein content of 12.27%. This variation may be attributed to the drying method and it could be said that freeze drying and solar drying does not have effect that is significantly different from each other. The statistical analysis as shown in the Table 2 shows that there is a significant difference between the effect of solar drying and oven drying methods $p \leq 0.05$. The protein contents (%) of the solar dried and oven dried sample were 15.28 and 12.27%, respectively. The difference between the effect of oven drying and freeze drying may be attributed to the effect of various drying methods on the nutritional composition of foods. Fellows[15] reported heat processing like other types of processing and preservation techniques result in losses of minerals, water-soluble vitamins and other water soluble components.

The ash content of the sample was also shown in the Table and the variations between the raw sample and the raw subjected to osmostic dehydration can also been seen. The ash content of the raw sample was 10.79% and that of the raw subjected to osmotic dehydration was 8.93% and the difference well depicts the effect of osmotic dehydration on the proximate content of the sample. The variation in the proximate composition of the red bell pepper sample subjected to osmotic dehydration followed by different drying methods can be attributed to the drying methods.

Table 2: Proximate composition of red bell pepper on dry basis

Samples	% Protein	% Ash	% Fat	% Crude fibre	% Cho
Raw	27.22^{a} ±0.21	10.79^{a} ±0.39	15.78^{a} ±0.16	0.67 ±0.12	45.49^{d} ±0.12
Osmosised raw	15.47^{b} ±0.08	8.93^{b} ±0.45	11.60^{b} ±0.14	0.22 ±0.04	63.37^{c} ±0.02
Freeze dried	15.30^{c} ±0.03	8.77^{b} ±0.02	11.52^{c} ±0.02	0.16 ±0.02	64.25^{b} ±0.04
Solar dried	15.28^{c} ±0.02	8.70^{b} ±0.02	11.58^{c} ±0.08	0.20 ±0.03	64.32^{b} ±0.03
Oven dried	12.27^{d} ±0.08	8.35^{c} ±0.02	11.38^{d} ±0.02	0.21 ±0.02	67.79^{a} ±0.03

Values are means of three replicates values in a column denoted by different letters differ significantly at $p<0.05$

Table 3: Vitamin C and water absorption capacity of red bell pepper dried using different drying methods

Samples	VIT. C (mg/100g)	WAC % v/w
Raw	200	50
Osmosized raw	150	100
Freeze dried	125	350
Solar dried	100	250
Oven dried	125	300

Similar variations can be seen in the crude fibre, fat and carbohydrate contents of the samples, respectively. Table 3 shows Vit. C and the water absorption capacity of the sample. The vitamin C content of the raw sample was 200 mg/100 g while that of the raw sample subjected to osmotic dehydration was 150 mg/100 g also the freeze dried sample has a vitamin C content of 125 mmg/100 g and the solar dried and oven dried sample was 100 mg/100 g and 125 mg/100 g, respectively. From the table; the ascorbic acid (vitamin C) content of the sample dried is less than the vitamin C content of the raw sample.

This was in agreement with the work of Shittu[16] who reported that drying of vegetables leads to some losses of ascorbic acid and some sensory characteristics. He added that more severe drying conditions in oven caused higher losses of ascorbic acid. Also this variation might be due to the leaching of the vitamin being water soluble and oxidation due to longer period of drying especially the solar dried sample.

The Water Absorption Capacity (WAC) of the sample was also shown in Table 3. the WAC of the raw sample was 50%v/w and the raw subjected to osmotic dehydration was 100%v/w while those subjected to various drying methods were 350% for freeze dried; 250%v/w for solar dried and 300%v/w for oven dried samples. This increase in WAC may be attributed to the processing methods. Processing methods have been reported to affect WAC of plant materials Wu and

Inglett[17] reported that WAC of soy flour increased due to heat processing. WAC values ranging from 149.1 to 471.5%v/w are considered critical in viscous foods such as soups and gravies. The value for WAC compared favourably with the WAC reported for some seeds by Oshodi and Ekperigen[18]. The WAC of the dried sample suggested that they may be of valuable use in soup preparation.

CONCLUSION

It can be concluded from the results of this study that each drying method resulted in increase of absorption capacity of dried red bell pepper sample meaning that dried pepper can find a valuable application in soups and gravies.and reduction of the proximate composition of the red bell pepper with freeze drying retaining the highest amount of protein drying methods

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