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

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**Abstract:** This study was carried out to investigate 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 with improved qualities. Red bell pepper were dipped in osmotic sugar solution (60°Brix) at 40°C for 9 h at 30 min interval for the first two hours and at 1 hour interval for the remaining seven hours respectively. The osmosised samples were then freeze dried, oven dried and solar dried. They were then analysed for their proximate composition, vitamin C content and Water Absorption Capacity (WAC). The result of the proximate composition showed that the freeze dried sample that contained, 15.30% protein, 8.77% Ash, 11.52% fat, 0.16% crude fibre and 64.25% carbohydrate was the best when compared 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 also highest in the freeze dried samples with 150 mg $100^{-1}$ g and 100% v/w compared to the raw pepper with 200 mg $100^{-1}$/100 g and 50% v/w, respectively. These results indicated that freeze drying method was the best resulting in less reduction in protein and vitamin C content and with increased 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 Danise Coon[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 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 Tunde-Akintunde *et al.*[6].

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Table 1: Nutritional composition of red-bell pepper

| Nutrient | Composition |
|---|---|
| Moisture | 74% |
| Food energy | 9.4 Calories |
| Protein (%) | 4.1 |
| Fat (%) | 2.3 |
| Calcium (per 100 g) | 58 mg |
| Iron (per 100 g) | 2.9 mg |
| Thiamine (per 100 g) | 0.25 mg |
| Riboflavin (per 100 g) | 0.20 mg |
| Niacin (per 100 g) | 2.4 mg |
| Ascorbic acid (per 100 g) | 121.0 mg |

Source: Ngoddy and Ihekoronye,[1]

Pretreatment excluding the use of chemical may have great potential in food processing. Ade-Omowaye *et al.*[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 *et al.*[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 work 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 and to reduce microbial load. The stalk was removed; blotted with tissue paper and then weighed. Osmotic solution of 60° Brix concentration was prepared[7] using the equation below:

$$\frac{x}{x+y} = z\%$$

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 min 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 weighing 8.843, 9.125, 8.694 and 9.789 g were put in an oven at a temperature of 50°C until constant weight were recorded Ade Omowaye *et al.*[7]. After drying, the samples were 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 Agricultural Engineering department, Federal university of Technology, Akure for 5 days when constant weight was 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 $Hg^{-1}$ 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 dessicator and sealed for storage.

**Analysis of the samples**

**Chemical analysis:** The proximate composition of each sample were determined based on the standard methods.

**Water absorption capacity (WAC) determination:** Water absorption capacity was determined using the method of Sathe *et al.*[14].

**Vitamin C determination:** Vitamin C content was determined using the 2, 6, dichloroindophenol titration method.

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

| Samples | Protein (%) | Ash (%) | Fat (%) | Crude fiber (%) | Carbohydrate (%) |
|---|---|---|---|---|---|
| Freeze dried | $15.30^{c}\pm0.03$ | $8.57^{b}\pm0.02$ | $11.52^{b}\pm0.02$ | $0.16^{c}\pm0.02$ | $64.25^{b}\pm0.04$ |
| Raw | $27.27^{a}\pm0.21$ | $10.79^{a}\pm0.39$ | $15.78^{a}\pm0.16$ | $0.67^{a}\pm0.12$ | $45.49^{d}\pm0.12$ |
| Osmosised | $15.47^{b}\pm0.08$ | $8.93^{b}\pm0.45$ | $11.60^{b}\pm0.14$ | $0.63^{a}\pm0.04$ | $63.37^{c}\pm0.02$ |
| Solar drying | $15.28^{c}\pm0.03$ | $8.70^{b}\pm0.02$ | $11.50^{b}\pm0.08$ | $0.20^{b}\pm0.03$ | $64.32^{b}\pm0.03$ |
| Oven dried | $12.27^{d}\pm0.08$ | $8.35^{c}\pm0.02$ | $11.38^{c}\pm0.02$ | $0.21^{b}\pm0.02$ | $67.7^{a}\pm90.03$ |

*Values are means of three replicates $^{a,b,c}$Values in a column denoted by different letters differ significantly at $p<0.05$

## RESULTS AND DISCUSSION

Table 2 shows the proximate composition of fresh red bell pepper, osmostically dehydrated. both before drying and after subjecting it to various types of drying methods, on dry basis. The protein content of the raw sample before subjecting to osmotic dehydration 27.27% was 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 showed that there exist a significant difference $p\leq0.05$ 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 had 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 resulted 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 those 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. Similar variations can be seen in the crude fibre, fat and carbohydrate contents of the samples, respectively.

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

| Samples | Vit C (mg $100^{-1}$ g) | WAC (%v/w) |
|---|---|---|
| Raw | 200.13 | 50 |
| Osmosised | 150.01 | 100 |
| Freeze dried | 125.23 | 350 |
| Solar dried | 100.32 | 250 |
| Oven dried | 125.21 | 300 |

Table 3 shows Vitamin C and the Water absorption capacity of the sample. The vitamin C content of the raw sample was 200 mg $100^{-1}$/100 g while that of the raw sample subjected to osmotic dehydration was 150 mg $100^{-1}$/100 g also the freeze dried sample has a vitamin C content of 125 mg $100^{-1}$/100 g and the solar dried and oven dried sample was 100 and 125 mg $100^{-1}$/100 g, respectively. From the table; the ascorbic acid (vitamin C) content of the sample dried is less than the that of the raw sample. This was in agreement with the work of Shittu *et al.*[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. There was also a reduction of the proximate composition of the red bell pepper with freeze drying retaining the highest amount of protein drying methods

## REFERENCES

1. Ngoddy, P.O. and A.I. Ihekoronye, 1985. Intergrated Food Science and Technology for the Tropics. Macmillan Publishers Limited, London/Basingstoke. pp: 198-190.
2. Ibrahim, D. and P. Mehmet, 2002. Hot air drying characteristic of red bell pepper. J. Food Eng., 55: 331-335.
3. Donglin, Z. and H. Yasunori, 2003. Phenolic Compounds: Ascorbic Acid, Carotenoids and Anti-oxidant Properties of Green, Red and Yellow Bell Pepper. J. Food Agric. Environ., pp: 22-27.
4. Danise, C., 2003. Chile Pepper: Heating up Hispanic Foods. Develop. Food, 1: 39-43.
5. Jasim, A., V.S. Shivhare and S. Debnnath, 2002. Colour Degradation and Rheology of Green Chilli Puree during Thermal Processing. Intl. Food J. Sci. Tech., 37: 1-57.
6. Tunde-Akintunde, T.Y., T.J. Afolabi and B.O. Akintunde, 2005. Influence of Drying Methods on Drying of Bell Pepper (*Capsicum annum*). J. Food Eng., 68: 439-442.
7. Ade-Omowaye, B.I.O., P. Talens, A. Angersbuch and D. Knorr, 2003. Kinetics of Osmotic Dehydration of Red Bell Pepper as Influenced by Pulse Electric Field Pre-treatment. Food Res. Intl., 36: 475-482.
8. Anna, K., A.B. Jane and C. Jean, 1983. Ascorbic acid and folic acid content and sensory characteristic of Dehydrated Green Pepper. J. Food Sci., 48: 1246-1249.
9. Bolin, H.R., C.C. Huxsoll, R. Jackson and K.C. Ng, 1983. Effect of osmotic agent and concentration on fruit quality. J. Food Sci., pp: 48-202.
10. Lerici, C.R., G. Pinnavaia, R.M. Dalla and L. Bartolucci, 1985. Osmotic dehydration of fruits. Influence of osmotic agent on drying behaviour and product quality. J. Food Sci., 50: 1217-1218.
11. Shakuntala, M.N. and M. Shadaksharaswamy, 1987. Foods facts and principles. Published by Mohinder Singh Sejwal for Wiley Eastern Limited, pp: 129-491.
12. Raoult-Wack, A.L., 1994. Recent advance in the osmotic dehydration of foods. Trends in Food Sci. Tech., pp: 5-255.
13. Banu, F.O., L.D. Lisa, O. Murat and D.F. John, 2002. Processing factors affecting the osmotic dehydration of diced green pepper. Intl. J. Food Sci. Tech., 37: 5-497.
14. Sathe, S.K., S.S. Desphande and D.K. Salunkhe, 1982. Functional properties of winged bean (*Psophocarpus tetragonolobus* (L) (D.C)) Proteins. J. Food Sci., 47: 503-509.
15. Fellow, P.J., 1990. Food Processing Technology, principle and practice. Published by Ellis Horwood, pp: 207.
16. Shittu, T.A., O.A. Ogunmoyela and L.O. Sanni, 1999. Nutrient retention and sensory characteristics of dried leafy vegetables: In 23rd Annual NIFST Conference, 25th-27th October Proceedings, Abuja.
17. Wu, Y.U. and G.E. Inglett, 1974. Denaturation of plant proteins related to functionality and food application. J. Food Sci., pp: 39-218.
18. Oshodi, A.A. and M.M. Ekperigen, 1989. Functional properties of pigeon pea (*Cajanus cajan*) flour. Food Chem., 34: 187-191.