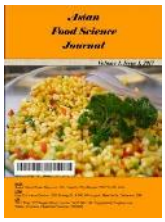

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Effect of Processing on Mixed Vegetables

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Authors' contributions

This work was carried out in collaboration between all authors. Author SGI designed and supervised the study. Author ASI participated in the study and carried out the statistical data analysis. Author MYS managed the literature searching and wrote the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: Tomato, onion and pepper are vegetables that are considered for well-balanced diets since they supply vitamins, minerals, dietary fiber, and phytochemicals, they are consumed daily by all classes of population and dried against off-season.
Objective: This study was conducted to determine the effect of Blanching on proximate composition, vitamins and minerals of fresh and dried mixed vegetables.
Methods: The vegetables were cut into slices and mixed in the ratio 5:3:2 (tomatoes, onions and pepper) respectively and subjected to homogenization. The homogenized vegetables were then divided into 3 groups; fresh, blanched and un-blanched. Both blanched and un-blanched were evaporated, pasteurized and dried using solar dryer.
Results: The moisture content of fresh is (94.97±0.06 g%) which is significantly higher at $P<0.05$ with blanched (20.52 ±0.51 g%) and also with un-blanched (24.16±0.23 g%). The Ash content of fresh is (0.99±0.01 g%) which is significantly lower at $P<0.05$ with blanched (1.23±0.25 g%) but not significant difference with un-blanched $P=0.05$ (0.99±0.01g%), The Crude protein content of fresh is (24.04±0.04 g%) which is significantly higher at $P<0.05$ with blanched (20.20±0.02 g%) and also with un-blanched (22.60±0.25 g%). The fiber contents of fresh is (1.30±0.03 g%) which is not significant $P>0.05$ with Blanched (1.23±0.02 g%) and un-blanched (1.48±0.06 g%). The mineral content of fresh are (Ca^{2+} 0.57 ± 0.02 mg/kg, Mg^{2+} 1.87 ± 0.11mg/kg, Na^{+} 324.33 ± 4.04 mg/kg, K^{+}

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910.00 ± 10.00 mg/kg and P 2.49±0.29 mg/kg) which are significantly higher at $P<0.05$ with blanched (Ca^{2+} 0.31±0.01 mg/kg, Mg^{2+}1.13±0.06 mg/kg, Na^{+}256.25 ± 8.75 mg/kg, K^{+} 533.33 ± 15.88 mg/kg and P 4.45 ± 0.01 mg/kg) and also with un-blanched (Ca^{2+}0.36 ± 0.01 mg/kg, Mg^{2+} 1.65 ± 0.01 mg/kg, Na^{+} 211.83±3.18 mg/kg, K^{+} 733.33 ± 12.51 mg/kg and P 3.90±0.10 mg/kg). The Vitamin content of fresh are (Vitamin A 16.2±5.00 g/100 g, Vitamin C 2.26 ±0.12 g/100 g and Vitamin E 12.82±3.06 g/100 g) which are significantly higher at $P<0.05$ with blanched (Vitamin A 1.75 ±0.07 g/100 g, Vitamin C 1.5 ±0.06 g/100 g and Vitamin E 4.32±0.1 5 g/100 g) and also with un-blanched (Vitamin A 1.20±0.05g/100g, Vitamin C 2.02±0.11g/100g and Vitamin E 3.00 ±0.12 g/100 g).

Conclusion: These results indicate that blanching reduces the minerals, proximate and vitamins contents of mixed vegetables than the un-pre-processed samples.

Keywords: Blanched; dried; evaporate; fresh; mixed vegetables.

1. INTRODUCTION

Vegetable make up a major portion of the diet of human in many parts of the world and play a significant role in human nutrition, especially as sources of phytonutriceuticals: Vitamins (C, A, B1, B6, B9 and E), minerals, dietary fiber and phytochemicals [1] some phytochemicals of vegetables are strong antioxidants and are thought to reduce the risk of chronic diseases by protecting against free-radical damage, by modifying metabolic activation and detoxification of carcinogens, or even influencing processes that alter the course of tumor cells [2]. Vegetable in the daily diet have been strongly associated with overall good health, improvement of gastrointestinal health and vision, reduced risk for some forms of cancer, heart disease, stroke diabetes, anemia, gastric ulcer, rheumatoid and arthritis and other chronic diseases [3].

Tomatoes (*Lycopersicum esculantum*) are the major source of antioxidant lycopene [4] which has been linked to many health benefits, including reduced risk of heart disease and cancer. Tomatoes are great source of vitamin (C and K), minerals such as potassium, calcium, sodium, phosphorus and so on [5]. It is one of the most widely consumed fresh vegetables in Africa. It is also widely used by the food industries as raw material for production of derived product such as purees or ketchup. Tomato is also the most common vegetables in the Mediterranean diet; a diet known to be beneficial for health, especially with regard to the development of chronic degenerative disease [6]. Compositionally, tomato has a unique nutritional and phytochemical profile. The major phytochemicals in tomato are the carotenoids consisting of lycopene, neurospene and carotenes [7].

Onion (*Allium sepa*) is an essential part of the diets of many Nigerians and like other vegetables, it provides vitamin such as Vitamin A and C, and a good amount of mineral element to the human body [8]. In addition, onion is among the food plants to which moderate levels of anticancer activities is associated with [8]. Onion is an excellent source of calcium, potassium, and manganese providing up to 10% of human daily requirement of these element onion are rich source of dietary fibers and especially of inulin, a polyfructosan [9]. It has prebiotic properties as it is preferably fermented by beneficial bowel bacteria like *lactobacilli* and *Bifidobacteria*, thereby altering the bacterial mycoflora of the intestine in such a way that pathogenic or harmful bacteria become less abundant [9].

Peppers (*Capsicum spp*), which are grown worldwide are used extensively as a natural food colorant and seasoning agent due to attractive color, flavor and taste [10]. Pepper has high nutritive value and has long been recognized as excellent source of vitamin C, [10]; moreover, the vitamin C, Carotenoids, Polyphenol and other phytochemical in pepper are powerful antioxidants that destroy free radical [11]. The level of these compounds in pepper depends on many factors, including maturity, growing condition and climate [12]. Some of the health benefits of pepper are; it helps to prevent anemia (Vitamin C, B6 and Folate), help to support healthy eyesight especially night vision [12]. It also activates thermogenesis and increase metabolic rates [12]. Peppers are also consumed in fresh or powdered form. Pepper are also cooked with vegetables and commonly used to make paste, pickles and sauce. Vegetables such as tomato and pepper are perishable crops which deteriorate few days after harvest under ambient temperature. This is mainly due to high moisture contents and inability to maintain

physiological constancy. In Nigeria, they are among the mainly grown vegetables and are commonly eaten by all class in sauce and soups. Therefore, have to be preserved in a ready to use form (mixed vegetable). The major way of preserving this vegetable is by drying during seasonal production and also undergo preprocessing (blanching) before the preservation to meet the demand all year around and also conserved the nutrient and prevent micronutrient loses. This work was conducted to determine the effects of blanching on proximate composition, minerals and vitamins contents of fresh and dried mixed vegetables (tomatoes, onions and pepper).

2. MATERIALS AND METHODS

2.1 Sample Collection

Fresh samples of vegetables (tomatoes, onions, and pepper) were purchased from Daji market (Kasuwar Daji) Wammako L.G.A, Sokoto State. The vegetables were free from physical damage.

2.2 Sample Processing

The vegetables were washed with water and rinsed with distilled water which were wiped with an absorbent paper to removed surface water, the vegetables were cut with a cleaned knife into small pieces and mixed in ratio of 5:2:3 for tomatoes, onions and pepper respectively and divided into three (3) Groups A, B, and C. the group A were blanched using steam methods of blanching. Group B was the un-blenched while Group C was the control (fresh). The vegetables were grinded using blender, boiled, evaporated and pasteurized. After blending and boiling they were placed into separate container named A, B, and C for blenched, un-blenched and control respectively. The group A and B were dried in a solar dryer for 3 days. The dried samples and control (fresh) were used for the analysis such as proximate, vitamins and minerals analyses.

2.3 Chemicals and Reagents

All chemicals and reagents used in this work were of analytical grades.

2.4 Proximate Analysis

The moisture, ash, crude fibre and crude protein contents of the fresh and dried mixed vegetables were determined by standard method of AOAC [13].

2.5 Vitamins Contents

The vitamin A, C and E contents of the fresh and dried mixed vegetables were determined using spectrometric method according to AOAC [13].

2.6 Minerals Contents

Sodium and Potassium were determined using flame photometer. Calcium and Magnesium were determined using EDTA titration method. Phosphorus was determined using Bray number 1.

2.7 Statistical Analysis

Results were expressed as mean values and standard deviation of three (3) replicates. Data were analyzed using one-way Analysis of Variance (ANOVA) using Graph Pad Instat version 3.05 to test the level of significance at 5% probability ($P<0.05$). Turkey compare all columns was used to separate the means where significant differences existed.

3. RESULTS

3.1 Proximate Composition

The proximate composition of the fresh and dried mixed vegetables is presented in Table 1, the mean value of moisture content for control (fresh), blanched (dried) and un-blanched (dried) are 94.97 g%, 24.16 g% and 20.52 g% respectively. The moisture content of the control is significantly higher than the moisture content of blanched, and un-blanched at $P<0.05$, and no significant difference between blanched and un-blanched $P>0.05$. The mean value of Ash content for control (fresh), blanched (dried) and un-blanched (dried) are 0.93 g%, 1.23 g% and 0.99 g% respectively. There is significant decrease in the ash content of blanched to that of control and the ash content of blanched is significantly higher than that of un-blanched. There is no significant difference between control and un-blanched $P=0.05$. The mean value of fiber content for control, blanched and un-blanched are 1.30 g%, 1.23 g% and 1.48 g% respectively. There is no significant difference between the control, blanched and un-blanched $P>0.05$. The crude protein contents for control, un-blanched and blanched are 24.045 g%, 20.20 g%, 22.60 g% respectively. There is significant

Table 1. Proximate composition of fresh and dried mixed vegetables (tomatoes, onions and pepper)

	Moisture (g %)	Ash (g %)	Fibre (g %)	Crude protein (g %)
Control	94.97±0.06[a]	0.93±0.12[a]	1.30±0.03[a]	24.04±0.04[a]
Blanched	24.16±0.23[b]	1.23±0.25[b]	1.23±0.02[a]	20.20±0.04[b]
Un-blanched	20.52±0.51[c]	0.99±0.01[a]	1.48±0.06[a]	22.60±0.25[c]

Values are mean ± SD of three (3) replicates. The mean bearing the same superscript within the same column are not significantly difference. Mean with different superscript at the same column are significantly different at P <0.05.

Table 2. Vitamins Content of Fresh and Dried Mixed Vegetables (tomatoes, onions and pepper)

	Vitamin A	Vitamin C	Vitamin E
		(g/100 g)	
Control	16.20±5.00[a]	2.26±0.12[a]	12.82±3.06[a]
Blanched	1.75±0.07[b]	1.50±0.06[b]	4.32±0.15[b]
Un-blanched	1.20±0.05[c]	2.02±0.11[c]	3.00±0.12[c]

Values are mean ± SD of three (3) replicates. The mean bearing the same superscript within the same column are not significantly difference. Mean with different superscript at the same column are significantly different at P <0.05.

decrease in the crude protein content of blanched and un-blanched as compared with control.

3.2 Vitamin

The vitamin content of fresh and dried mixed vegetable is presented in Table 2. The mean value of Vitamin A content for control (fresh), blanched (dried) and un-blanched (dried) are 16.20 g/100 g, 1.75 g/100 g and 1.20 g/100 g respectively. There is significant decrease in vitamin A of blanched and un-blanched with that of control, and significantly higher vitamin A in blanched as compared with un-blanched at (P<0.05).

The mean value of Vitamin C content for control (fresh), blanched (dried) and un-blanched (dried) are 2.26 g/100 g, 1.50 g/100 g and 2.02 g/100 g respectively. There are significant decrease between control and blanched, and significant increase between blanched and un-blanched but no significant difference between control and un-blanched at (P>0.05).

The mean value of Vitamin E content for control (fresh), blanched (dried) and un-blanched (dried) are 12.82 g/100 g, 4.32 g/100 g and 3.00 g/100 g respectively. The vitamin E content of control is significantly higher than that of blanched and un-blanched P<0.05, and there is significant decrease in vitamin E content of un-blanched when compared with blanched P<0.05.

3.3 Minerals

The minerals content of fresh and dried mixed vegetables is presented in Table 3. The mean value of Calcium ion contents for control (fresh), blanched (dried) and un-blanched (dried) are 0.57 mg/kg, 0.31 mg/kg and 0.36 mg/kg respectively. There is significant decrease in Calcium ion content of blanched and un-blanched when compared with that of control. There is no significant difference between blanched and un-blanched P>0.05. The mean value of Magnesium ion content for control (fresh), blanched (dried) and un-blanched (dried) are 1.87 mg/kg, 1.13 mg/kg and 1.65mg/kg respectively. The Magnesium ion content of control is significantly higher than that of blanched and un-blanched. The mean value of sodium ion content for control (fresh), blanched (dried) and un-blanched (dried) are 324.33 mg/kg, 256.25 mg/kg and 211.83 mg/kg respectively. There is significant decrease in sodium ion content of blanched and un-blanched with control at (P<0.05). The mean value of Potassium ion content for control (fresh), blanched (dried) and un-blanched (dried) are 910.00 mg/kg, 533.33 mg/kg and 733.33 mg/kg respectively. There is significant decrease in Potassium ion content of blanched and un-blanched with that of control, and the Potassium ion content of un-blanched is significantly higher than that of blanched P<0.05. The mean value of phosphorus for control (fresh), blanched (dried) and un-blanched (dried) are 2.49 mg/kg,

Table 3. Mineral content of fresh and dried mixed vegetables (tomatoes, onions and pepper)

	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	P
	(mg/kg)				
Control	0.57±0.02[a]	1.87±0.11[a]	324.33±4.04[a]	910.00±10.00[a]	2.49±0.29[a]
Blanched	0.31±0.01[b]	1.13±0.06[b]	256.25±8.75[b]	533.33±15.88[b]	4.45±0.01[b]
Un-blanched	0.36±0.01[b]	1.65±0.01[a]	211.83±3.18[c]	733.33±12.51[c]	3.90±0.10[c]

Values are mean ± SD of three (3) replicates. The mean bearing the same superscript within the same column are not significantly difference. Mean with different superscript at the same column are significantly different at P <0.05.

4.45 mg/kg and 3.90 mg/kg respectively. There is significant increase in phosphorus content of blanched and un-blanched as compared with control $P<0.05$.

4. DISCUSSION

4.1 Effect of Pre, and Post Processing on Proximate Composition

The significant difference in moisture content between control (fresh) and un-blanched (dried) was due to the fact that, the control was not evaporated neither dehydrated. Fresh vegetables are expected to have high moisture content than dried ones. This can also be due to pre-processing (blanching) that was not done to the fresh sample. The significant difference in moisture content between blanched and un-blanched samples was because the blanched sample undergoes blanching and this might have enhanced the drying process. The high moisture content in control (fresh) might favour high proliferation of micro-organism which might lead to quick spoilage of the vegetables. This is because the propensity of micro-organism to grow in food depends on the water activity of the sample and the shelf life of the fresh will be poor due to high water content that could enhance activities of inherent enzymes, this is because the activities of enzymes depend on the moisture content. This would enable the blanched (dried) and un-blanched (dried) to have longer shelf life than control. The low moisture contents in blanched (dried) and un-blanched (dried) does not agree with report of [14] who reported 40.14% moisture in fresh tomatoes, 9.04% for un-blanched (dried) and 8.67% for blanched (dried). These differences might be due to different in the varieties of species, environmental differences, variation in methods of processing, differences in sample used as mixed vegetables were used in this study as against purely tomato used in the previous study.

The high ash content for blanched and un-blanched might be due to the post-processing (evaporation and drying). The significant difference in ash content between blanched and un-blanched may be due to pre-treatment that blanched sample undergo. The low ash content in control might be due to high moisture content in it. This is similar to [15] reported that there is increase in the ash content value with decrease in the moisture content.

The high fiber content of un-blanched and control might be due to the fact that, the samples did not undergo pre-processing. The significant differences in fiber content between control and blanched was due to the fact that, the fresh sample neither undergo pre-treatment nor post-processing. The significant difference in fiber content between blanched and un-blanched was due to pre-processing (treatment) undergone by the blanched sample or due to low moisture content. This was similar to the finding of [15] which also reported an increase in fiber content with reduction in moisture. Adequate intake of dietary fibre could help in prevention of constipation, diarrhea, increase bowel movement and could also lower the serum cholesterol level, risk of coronary heart disease, hypertension, constipation, diabetes, and colon breast cancer [16].

The high crude protein content of control (fresh) might be due to the fact that, the fresh neither undergo preprocessing nor post processing. The significant difference in crude protein content between blanched and un-blanched was due to pre-processing the blanched sample undergoes. The blanched (dried) and un-blanched still retained some percentage of Protein after drying, that meet up the Recommended Daily Allowance (RDA) of protein. But control (fresh) has high protein than blanched and un-blanched.

4.2 Effect of Pre, and Post Processing on Vitamins

The high vitamin A content for control (fresh) might be due to the fact that, the control (fresh) neither undergo preprocessing nor post

processing. The significant difference in vitamin A content between blanched and un-blanched was due to the pre-processing undergone by blanched sample. Vitamin A been a fat-soluble could not be loss as a result of blanching but, despite, the blanching, evaporation and drying process the blanched undergoes that might have led to decrease in vitamin A the quantity left might still contribute in meeting the RDA for both children and adults. The decrease vitamin A content of un-blanched could also meet RDA of both children and adults. Since mammals cannot synthesize vitamin A which is an important precursor to 11-cis-retinal a key chemical component in vision. Tomatoes, onions and pepper could be another source of meeting the 2.7 mg per day requirement [17].

The high vitamin C content of control (fresh) might be due to the fact that, the control (fresh) neither undergo neither pre-processing nor post-processing. The significant differences in vitamin C content between control, blanched and un-blanched might be due to the fact that, the blanched sample undergo pre-processing that why it has low vitamin C content compare to control and un-blanched that did not undergo pre-processing. The low vitamin C content in blanched sample was due to Leaching of vitamin C in blanching water and also application of heat to the sample during pre-processing, vitamin C being water soluble and sensitive to thermal treatment). Despite the blanching, evaporation and drying the blanched undergoes that lead to decrease in vitamin C when compare with control (fresh) the quantity left could be enough to meet the RDA for both children and adults. Despite the post processing the un-blanched undergoes that lead to decrease in vitamin C when compare with control (fresh) amount left of could contribute in meeting the RDA of children and adults. Vitamin C is a water soluble vitamin it plays role in human health and disease, collagen formation, bone formation, iron and hemoglobin metabolism, tryptophan metabolism, tyrosine metabolism, folic acid metabolism, peptide hormone synthesis, regeneration of other vitamins and immunological functions [18]. Human beings are among the few vertebrates that cannot synthesize vitamin C which is an important antioxidant in the body [17]; this vitamin need to be supply in the diet and appreciable amount could be obtain in the processed vegetables.

The high vitamin E content of control (fresh) might be due to the fact that, the control (fresh) undergoes neither pre-processing nor post-processing. The significant difference in vitamin E content between blanched and un-blanched was due to the fact that, the blanched undergo pre –processing and this enable it to have low vitamin E content. This was in line with the report of [17]. Despite the blanching, evaporation and drying the blanched undergo that lead to decrease in vitamin E when compare with control (fresh) appreciable amounts of were remained, which could meet RDA of human. Despite the post processing the un-blanched undergo that lead to reduction in vitamin E reasonable amount remains that could contribute in meeting the RDA of human. Vitamin E is a naturally occurring antioxidant vitamin, it play role in preventing lipid peroxidation, as membrane antioxidant, it protects RBC from hemolysis by oxidizing agent [18].

4.3 Effect of Pre, and Post Processing on Mineral Composition

The significant difference in Ca^{2+} content between control, blanched and un-blanched was due to the fact that, the control neither undergo pre-processing nor post-processing. The low Ca^{2+} of blanched sample might be as a result of preprocessing. Despite the reduction in Ca2+ content of both blanched and un-blanched mixed vegetables as a result of processing the amount remain could meet the RDA of humans. Calcium plays roles in blood coagulation, nerves transmission and membrane integrity and permeability [18]. Therefore, this vegetable could be a source of calcium. Calcium is also good for growth and maintenance of bones, teeth and muscles [19].

The significant difference in Mg^{2+} content between control, blanched and un-blanched was due to the fact that, the control was not processed. The low Mg^{2+} of blanched might be as a result of blanching. Despite the effect of processing on Mg^{2+} content of blanched and un-blanched mixed vegetables, the amount of Mg^{2+} left could contribute to the body requirement of $Mg^{2+.}$ Magnesium is an essential constituent of chlorophyll and also regulate the activities of many enzymes in plant [17], these might have accounted for reasonable level of this mineral in the mixed vegetables. The Magnesium content of tomatoes, onions and peppers vegetable mixed does not reach the Recommended Daily Allowance (RDA) of 350 mg/kg [17].

Despite the blanching, evaporation and drying of the mixed vegetables, appreciable amount of Na^+ was still retained which could contribute to body Na^+ requirement. Na^+ is the key electrolyte in the body it also regulates ATP-dependent channels in the transmission of nerve impulses in the brain, it also regulates acid-base balance, maintenance of osmotic pressure and fluid balance [18].

The high K^+ content in control (fresh) might be due to the fact that, the control was not processed. The high concentration of potassium in the mixed vegetables is not surprising because plants absorb K^+ in large amount from the soil than any other nutrient except nitrogen and Calcium [17]. Potassium plays roles in intracellular osmotic pressure, regulation of acid-base balance and water balance in the cells, transmission of nerves impulses [18].

The high Phosphorus content in blanched sample might be due to pre-treatment that the sample undergoes. The significant difference in P content between blanched, control and un-blanched was due to the fact that, the control and un-blanched samples do not undergo pre-treatment, blanching might have positive effect in increasing the availability of phosphorus in the mixed vegetables. The control (fresh) has low phosphorus content compared to blanched and un-blanched; this is because the control neither undergoes pre-processing nor post-processing. Phosphorous like calcium is an important component of body, large proportion of phosphorus is usually found in the body skeleton in the form of calcium phosphate ($Ca_{10}(PO_4)_6(OH)_2$). It could also be found in the soft tissues and blood largely as phospholipids, phosphoprotein and nucleic acid as well as inorganic phosphate [17].

5. CONCLUSION

Processing drastically reduces the moisture content, vitamin A and E and increases the ash content and phosphorus levels of the mixed vegetables. Pre and post processing have moderate effect on the nutrient contents of the vegetables and appreciable level of nutrients were still available to meet/contribute to the recommended daily intake of both adults and children.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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