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THE EFFECT OF PRETREATMENT AND DRYING ON SOME VITAMIN CONTENTS OF TOMATO POWDER

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Abstract
Tomatoes are very popular fruit rich in vital vitamins and minerals, but highly perishable once harvested. Sun drying is one of the most common methods of tomato preservation in Nigeria resulting in an unattractive dried tomato chips. The objective of this work is to evaluate the effect of sun and oven drying methods and pretreatment on some vitamins content of tomato powder. With the initial ascorbic acid, thiamin, riboflavin, niacin and β.Carotene contents of freshly harvested tomatoes determined, twenty kilograms of tomatoes were washed, sorted and divided into four equal portions of 5kg each. The first and second portions were sun and oven dried respectively; while the third and fourth were dipped in 1% metasulphite for 5 minutes. The third and fourth portions were then sun dried and oven dried. Vitamin contents of samples were determined using standard methods. Results showed that drying generally increases the ascorbic acid, thiamin, niacin and β.Carotene content of tomato powder significantly ($p<0.05$) compared to the fresh ones. Drying and pretreatment has no significant effects ($p<0.05$) on the riboflavin content of tomatoes. The use of metasulphite as pretreatment resulted in a lower increase in the vitamin content as compared to the untreated samples. Sun dried samples had higher vitamin content than the oven dried samples. It can be concluded that drying and pretreatment does not have significant effect on the riboflavin content of tomato. Sun drying method is the most suitable for tomato drying the terms of increased vitamin content compared to oven drying method.

Keywords: Oven drying, Pretreatment, Sun drying, Tomato, Vitamins

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1. INTRODUCTION

Tomato (*Lycopersion esculentum*) is one of the most popular and widely consumed vegetables grown worldwide with an annual production of more than 120 million tons in the world (Anon, 2010, Andrew, 2000). Tomato fruits are berries with different forms and dimensions. Tomatoes consist of:

i. Epicarp - the external layer of polygobal cells
ii. Mesocarp – the pulpy part of the epicarp that have been formed by cells with thin round walls. When ripe, it contains grains of a red coloured material called lycopene and a liquid which is a water solution of flavor and savory compounds.
iii. Endocarp - the thicker tissue that divide and limit the pulp sections.

Tomato is an important source of vitamin A and C in the western diet. It also contains a significant amounts of dietary fiber, beta-carotene, iron, lycopene, magnesium, niacin, potassium, phosphorous, riboflavin and thiamine. Tomato is low in saturated fat, cholesterol and sodium. Tomatoes can be eaten raw, with salad or mixed with meat, pulse and vegetable dishes. Slices of red tomatoes are used for garnishing. Cooking or processing of tomato (e.g. tomato paste, ketchup, tomato soup, and tomato sauce) maintains its lycopene content. Test also shows that eating tomatoes has more benefits (with all of its other ingredients) than taking lycopene alone (USDA, 2005). Tomatoes contain several important vitamins which are essential constituents of food (Table 1). Vitamins are organic chemicals, other than essential amino acids and fatty acids that must be supplied to an animal in small amounts to maintain health. Vitamins function in enzyme systems which facilitate the metabolism of proteins, carbohydrate and fats. The vitamins are divided into two major groups; the fat soluble and water soluble group. The fat soluble vitamins

are vitamins A, D, E and K their absorption by the body depend on the normal absorption of fat from the diet. Water soluble vitamins include vitamin C and several members of the vitamin B complex.

Table 1: The Vitamins Content of Fresh Tomato

Vitamins	Per 100g
Vitamin C	13mg
Vitamin B-6	0.08mg
Vitamin A	833 IU
Vitamin E	1.2 mg
Vitamin K	9.7 mcg
Folate Total	18 mcg
Folate Food	18 mcg
Thiamin	0.046 mg
Riboflavin	0.023 mg
Niacin	0.731 mg
Pantothenic acid	0.109 mg
Tocopherol, beta	0.01 mg
Tocopherol, gamma	0.15 mg
Beta carotene	552 mcg
Alpha carotene	124 mcg
Lycopene	3,165 mcg

Source: USDA, 2005

A medium sized tomato contributes 40% of ascorbic acid (vitamin C), which is important in forming scollagen, a protein that gives structure to bones, cartilage, muscle, and blood vessels and aids in the absorption of iron. Ascorbic acid is necessary for healthy teeth, gums and is essential for proper functioning of adrenal and thyroid glands. It is also an anti-oxidant and as such acts as a general de-toxicant. Tomatoes supplies 20% of vitamin A which plays a role in vision, our immune system, skin health and other health benefits. Vitamin A is needed for maintenance of skin, mucous membranes, bones, teeth, hair, vision and reproduction. Tomatoes contribute 15% of vitamin K, which is known as the blood clothing vitamin.

Thiamine is needed for nervous system and helps release energy from carbohydrates. Riboflavin helps release energy from foods and is essential for healthy eyes, skin, nails and hair. Pyridoxine helps form red blood cells and is needed for metabolism, normal reproductive process and healthy pregnancies. Vitamin E also acts as an antioxidant and protects cell walls (Harper, 1999; Wardlaw and Kessel, 2002). Thus tomatoes could be a valuable source of dietary vitamins in human nutrition.

Tomato is a major agricultural crop cultivated in Nigeria, especially in the northern parts, it has been reported that over six million tones of tomatoes are produced annually, with about 50 % lost between rural production and town consumption in the tropical areas (Zvi, 2000). Tomato has a limited shelf life at ambient conditions and is highly perishable this makes its preservation inevitable. Sun drying is one of the most common methods of preservation in Nigeria due to its vest availability all the year round. A large percentage of the tomatoes produced in the northern part of Nigeria are usually sun dried on the bear ground to avoid wastages which results in an unattractive dried tomato chips. The main objective of this work is to evaluate the effect of pretreatment and drying method on some vitamin content of tomato powder.

2. MATERIAL AND METHODS

2.1 Tomato Powder Preparation

Twenty five kilogram (25 Kg) of freshly harvested tomatoes (Roma variety) was purchased from a vegetable market in Ibadan Nigeria. Tomatoes were sorted and washed with distil water to remove dirt and soil. The initial ascorbic acid, thiamin, niacin and β.Carotene content of the fresh tomatoes were determined using standards methods as prescribed by AOAC, 1999. Tomatoes were cut into slices of approximately 6 mm thickness each using a fruit slicer. The sliced tomatoes were divided into four portions of 5 Kg each. The first portion was sun dried, the second was oven dried while the third and fourth were dipped in 1% sodium metasulphite for five (5) minutes. The third was then sun dried while the fourth was oven dried. Drying for all the samples was continued until the weights remains constant in 3 consecutive readings. All the samples were subsequently milled using a blender. The ascorbic acid, thiamin, niacin and β.Carotene contents of tomato powder samples were determined as prescribed by AOAC, 1999. All experiments were carried out in three

replicates. Data collected were analyzed statistically using the SPSS 15.0 statistical package to determine the analysis of variance and the Duncan multiple range tests were used to separate the means.

3. RESULTS AND DISCUSSION

The results as presented in Table 2 shows that the ascorbic acid, thiamin, niacin and β.Carotene content of fresh tomatoes increases with drying irrespective of the use of pretreatment and drying method used. This could be due to concentration effect which is as a result of the reduction in the moisture content compared to the fresh tomatoes. The analysis of variance shows that there are significant variations ($p < 0.05$) in the vitamin content of the dried tomato powder compared to the fresh tomatoes (Table 3).

Table 3: The effect[1, 2] of drying method and pretreatment on the vitamin content (mg/100g) of tomato powder

S/N	AC	Th	Rb	Nc	β.C
A	33.50^{d}	0.10^{e}	0.05	0.55^{d}	385.00^{e}
B	43.50^{b}	0.40^{a}	0.10	1.10^{b}	537.50^{b}
C	49.00^{a}	0.35^{b}	0.20	1.15^{a}	572.50^{a}
D	39.00^{c}	0.25^{d}	0.15	1.00^{b}	492.50^{d}
E	43.50^{b}	0.30^{c}	0.12	0.95^{c}	511.00^{c}

[1]Means of three replicate [2]Means with the same letters for a particular measurement are not significantly different ($p \leq 0.05$).

Where;
A = fresh tomato
B = sun dried sulphited
C = sun dried uunsulphited
D = oven dried sulphited
E = oven dried unsulphited
AC = ascorbic acid
Th = thiamin
Rb = riboflavin
Nc = niacin
β.C = beta carotene

The sun dried unsulphited tomato powder had the highest increase in the ascorbic acid of 49.00 mg/100g, niacin of 1.15 mg/100g and β.Carotene of 572.50 mg/100g contents while the sun dried sulphited had the highest thiamin content of 0.40 mg/100g. The oven dried sulphited tomato powder had the least increase in ascorbic acid of 39.00 mg/100g, thiamin 0.25 mg/100g, and β.Carotene of 492.50 mg/100g while the oven dried unsulphited had the least increment in the niacin content of 0.95 mg/100g.

Statistical analysis shows that the drying method and pretreatment has significant effect ($p < 0.05$) on the ascorbic acid, thiamin, niacin and β.carotene of tomatoes powder, but however has no significant effect on the riboflavin content (Table 4). The ascorbic acid content was highest in the sundried unsulphited sample while the least was in the oven dried sulphited sample. Ascorbic acid is an anti-scurvy vitamin, it deficiency causes fragile capillary walls, easy bleeding of gums, loosening of teeth and bone joint disease. Like vitamin E, vitamin C favours the absorption of iron. Ascorbic acid is easily destroyed by oxidation, especially at high temperature; this could responsible for its least value in oven dried sulphited samples (Potter and Hotchkiss, 1997).

The thiamin content was highest in the sundried sulphited (0.40 mg/100g) and the least in the oven dried sulphited. The use of sulphite tends to enhance the increase in the thiamin content of tomato powder, affected by the use of oven drying method probably due to the high temperature. There was no significant difference in the niacin content of sundried sulphited and oven dried sulphited tomato powder this could be due to the fact that niacin has been reported to be resistant to heat, light and oxidation (Potter and Hotchkiss, 1997). Thiamin deficiency affects tissue respiration and oxidation of glucose and results in the disease known as pellagra in humans. Niacin is very stable to heat, light and oxidation, but like other water soluble nutrients it can be leached out from foods during processing and cooking. The highest was in the sundried unsulphited and the least in oven dried unsulphited. This shows that drying temperature does not have effect on the niacin content of the tomato powder, the use of sulphite and drying temperature (method) resulted in minimal increases in the niacin content of tomato powder.

Table 2: The effect of drying method and pretreatment on the vitamin content (mg/100g) of tomato powder

Sample	Ascorbic acid	Thiamin	Riboflavin	Niacin	β.Carotene
Fresh	33.50[d]	0.10[e]	0.05	0.55[d]	385.00[e]
Sun dried sulphited	43.50[b]	0.40[a]	0.10	1.10[b]	537.50[b]
Sun dried Unsulphited	49.00[a]	0.35[b]	0.20	1.15[a]	572.50[a]
Oven dried sulphited	39.00[c]	0.25[d]	0.15	1.00[b]	492.50[d]
Oven dried Unsulphited	43.50[b]	0.30[c]	0.12	0.95[c]	511.00[c]

Table 4: The ANOVA of the effect of drying method and pretreatment on the vitamin content of tomato powder

		Sum of Squares	df	Mean Square	F	Sig.
Ascorbic acid	Between Groups	402.54	4	100.64	782.14	0.00
	Within Groups	1.29	10	0.13		
	Total	403.83	14			
Thiamin	Between Groups	0.16	4	0.04	198.75	0.00
	Within Groups	0.00	10	0.00		
	Total	0.16	14			
Riboflavin	Between Groups	0.21	4	0.05	1.01	0.45
	Within Groups	0.52	10	0.05		
	Total	0.73	14			
Niacin	Between Groups	0.68	4	0.17	41.56	0.00
	Within Groups	0.04	10	0.00		
	Total	0.72	14			
β.Carotene	Between Groups	60170.57	4	15042.64	36102.34	0.00
	Within Groups	4.17	10	0.42		
	Total	60174.73	14			

[1] Means of three replicate [2]Means with the same letters for a particular measurement are not significantly different ($p \leq 0.05$).

The drying method and pretreatment does not have significant effect on the riboflavin content of tomato. Riboflavin function in the oxidative processes of living cells and is essential for cellular growth and tissue maintenance, its deficiency in human generally results in skin condition. Riboflavin is quite resistant to heat but very sensitive to light this could be the reason for its stability irrespective of the use of pretreatment and drying. This is similar to previous reports of Potter and Hotchkiss, 1997; Harper, 1999; Wardlaw and Kessel, 2002.

4. CONCLUSIONS

The use of metasulphite as pretreatment resulted in a lower increase in the vitamin content as compared to the untreated samples. The sun dried samples had higher vitamin content than the oven dried samples. The sun dried sulphited samples had the highest increase in thiamin indicating that pretreatment could enhance the increase in thiamin content in the processing of fresh tomato to powder. It can be concluded that drying and pretreatment does not have significant effect on the riboflavin content of tomato. The sun drying method is the most suitable for tomato drying the terms of increased vitamin content compared to oven drying method. The use of metasulphite might not be necessary for the increase in the ascorbic acid, thiamin, niacin and β.Carotene contents of tomato powder but may enhance the colour retention of dried tomato powder.

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