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Effect Of Drying Methods And Pretreatment On Some Physicochemical Quality Attributes Of Tomato Powder

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Abstract:

The effect of sun and oven drying methods and pretreatment on the physicochemical quality attributes of tomatoes powder was investigated. Twenty five kilograms of fresh tomatoes were sorted, washed and the initial physicochemical properties determined. The samples were divided into samples A, B, C and D. Sample A (dipped in 1% metasulphite and sundried), sample B (dipped in 1% metasulphite and oven dried), sample C (unsulphited sundried) and sample D (unsulphited oven dried) were taken as dried when the weights remains constant at three consecutive readings. The physicochemical properties of tomato powder were determined using standard methods and data collected were analyzed statistically. Results showed that drying and pretreatment has no significant effect (p< 0.05) on the total sugar content of tomatoes. The method of drying used and pretreatment resulted in significant increases in the ash, crude fiber and mineral content while the moisture and pH of tomatoes decreased significantly after drying. The sundried tomato powdered had the highest increase in mineral content. It is therefore recommended that sun drying method without the use of pretreatment should be used for tomato drying in terms of retained physicochemical quality attributes in cases where spray dryers are unavailable.

Keywords: *Tomato powder, drying, pretreatment, sun drying, oven drying*

1.Introduction

Tomato (Lycopersicon esculentun Mill) is botanically classified as a fruit and a member of the Solanaceae family. Tomato is a popular and versatile fruit that comes in over a thousand different varieties that vary in shape, size and colour. Tomatoes have fleshy internal segments filled with slippery seeds surrounded by a watery matrix; they can be red, yellow, orange, green, purple or brown in colour (Smith, 1994). Tomatoes are popular for their culinary properties and health benefits. They are a natural source of lycopene, a carotenoid that reduces the risk of cancer and coronary heart disease (Rao and Agarwal, 1999, Etminan, *et al*., 2004). Tomato, aside from being tasty, promotes healthy nutritional balance being a good source of vitamins A and C. Tomato may be eaten fresh as salad or processed into pastes, powder or purees, which are for cooking in stew or soup and producing fruit drinks. Tomato has a limited shelf life at ambient condition and it is highly perishable. It create glut during production season and becomes scarce during off season (Smith, 1994, FAO, 2006). One of the most important methods of reducing tomato losses is by drying which is a common form of food preservation. Drying agricultural products is aimed at reducing the moisture content of product to a level that allows the food to be stored safely for an extended period. In addition to increasing the shelf-life, drying reduces the weight and volume of the product, thereby reducing packing, storage and transportation costs. Dried tomato products are used for making pizza and various culinary dishes. During the drying process, the moisture content of the dried tomato product is typically reduced to less than or equal to 15% (Zanoni et al., 1999).

Tomato as other fruits and vegetable can be dried using various methods such as sun drying, spray drying, oven drying etc. The quality of dehydrated tomato depends on many parameters such as tomato variety, total soluble solid content of the fresh product, air humidity, size of the tomato segments, air temperature and velocity as well as the efficiency of the drying system and its drying power rate (Dewanto et al., 2002, Chen, et al, 2000, Olorun, 1990). Tomato powder is produced by drying fresh tomatoes. In advanced countries, tomato powder is made by turning fresh tomatoes into a slurry and spray drying. With spray drying, hot gas is forced through a liquid mixture, creating a fine powder which is used as a base for tomato paste. Tomato powder keeps longer than most tomato paste, and allows people to mix up exactly as much as they need for a fresh, dear flavour. It can also be used to make tomato soups, or to fortify broths and pasta sauces if they have a weak tomato flavour and a stronger one is desired (Hawlader et al., 1991, Gould, 1992).

The use of pretreatment on crops before drying is aimed at preventing fruits from darkening, many light-coloured fruits, such as apples, darken rapidly when cut and exposed to air. If not pretreated, these fruits will continue to darken after being dried (Lewicki et al., 2002, Hartz, 2008). The commonly used pretreatment methods as reported by Lewicki et al., 2002 are sulfuring, sulfite dip and syrup blanching. The main objectives of this work are to evaluate the effect of sun and oven drying methods and pretreatments on some physicochemical quality attributes of tomato powder.

2.Materials And Methods

The Roma variety tomato (Lycopersicon esculentun Mill) was used for this study. The fresh tomatoes were procured from a fruits and vegetable market at Bodija in Ibadan, Nigeria. The experiment and analysis were carried out at Kappa Bio-technology Institute at Bodija, in Ibadan, Oyo state. Twenty five kilograms of fresh tomatoes were sorted, washed and the initial physicochemical properties determined using AOAC, 1990 standard methods. The samples were divided into samples A, B, C and D. Sample A was dipped in 1% metasulphite for five minutes and sundried), sample B was dipped in 1% metasulphite for five minutes and oven dried, sample C was unsulphited sundried and sample D was unsulphited oven dried. All the samples were taken as dried when their weights remains constant at three consecutive readings. The physicochemical properties of tomato powder were determined using AOAC, 1990 standard methods and data collected were analyzed statistically using the 15.0 SPSS package.

3.Results And Discussion

3.1.Effect Of Drying Method And Pretreatment On Some Proximate And Physical Properties Of Tomato Powder

The results of the effects of drying method and pretreatment on some nutritional and physical properties were as presented in Table 1. The analysis of variances shows that the drying method and pretreatment used has significant effects ($p \leq 0.05$) on the moisture content, ash content, crude fiber, and pH of tomato powder (Table 2). It however does not have significant effects ($p \leq 0.05$) on the total sugar of tomato powder. The results showed that the use of pretreatment does not have significant effect of the final moisture content of tomato powder, but the drying method and temperature has. There were no significant differences in the final moisture of the sample A (sulphited sundried) and sample C (unsulphited sun dried). There were also no significant differences in the final moisture of the sample B (sulphited oven dried) and samples D (unsulphited oven). The final moisture content of the oven dried samples was however significantly lower than the sundried samples, this is probably due the higher drying temperature of the oven.

The use of pretreatments and drying increased significantly the ash content of tomato powder compared to the fresh tomato. The sample A (sulphited sun dried) has the highest ash content of 4.05% while sample D (unsulphited oven dried) has the least value of 2.50%. It also shows that the samples dried in the oven have lower ash content as compared to those dried in the sun. This is an indication that drying at a higher temperature decreases the ash content of tomato.

Samples	MC (%)	AC (%)	CF (%)	TSC (%)	pH
O	95.50^{c}	1.03^{a}	0.70^{a}	0.40	5.20^{c}
A	10.60^{b}	4.05^{e}	2.65^{c}	0.40	3.10^{b}
B	8.15^{a}	3.00^{c}	2.15^{b}	0.30	3.00^{ab}
C	10.90^{b}	3.25^{d}	2.55^{c}	0.45	2.95^{ab}
D	8.05^{a}	2.50^{b}	2.25^{b}	0.40	2.85^{a}

Table 1: [1,2]Effect of drying methods and Pretreatments on the proximate composition of the tomato powder

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

O = Fresh tomato
A = Sulphited sun dried
B = Sulphited oven dried
C = Unsulphited sundried
D = Unsulphited oven dried

		Sum of Squares	Df	Mean Square	F	Sig.
Moisture content	Between Groups	29340.0	5	5869.8	102083.5	0.0
	Within Groups	0.7	12	0.1		
	Total	29349.7	17			
Ash	Between Groups	26.3	5	5.3	822.5	0.0
	Within Groups	0.1	12	0.0		
	Total	26.4	17			
Crude fiber	Between Groups	12.4	5	2.5	662.2	0.0
	Within Groups	0.1	12	0.0		
	Total	12.5	17			
Total sugar	Between Groups	0.0	5	0.0	0.8	0.6
	Within Groups	0.1	12	0.0		
	Total	0.1	17			
pH	Between Groups	21.8	5	4.4	580.8	0.0
	Within Groups	0.1	12	0.0		
	Total	21.9	17			

Table 2: The ANOVA Of The Effect Of Drying Method And Pretreatment On The Proximate Composition Content Of Tomato Powder

The drying method used increased significantly the crude fiber content of tomato powder compared to the fresh tomato. The crude fiber content of sample B and D (oven dried samples) was significantly lower than samples A and C (sundried samples). There were no significant differences in the crude fiber of the sulphited and unsulphited tomato powder either sun dried or oven dried respectively. This is an indication that the use of pretreatment does not have significant effects on the crude fiber content of dried tomato powder, but the drying method will affect the crude fiber significantly.

The pretreatments and the drying methods decreased significantly the pH value of tomato powder compared to the fresh tomato. The results show that the pretreatment of tomato with sulphite before drying raised the pH value of the processed samples. Sun-drying of samples also increased the pH value of the processed samples. The maximum pH value of 3.1 was recorded in the sample pretreated with sulphite and sun-dried. However, the least pH value of 2.85 was observed in unsulphited oven dried sample.

This is an indication that pretreatment of tomato with sulphite and drying in the sun caused reduction in sample acidity.

3.2.Effect Of Drying Methods And Pretreatments On The Mineral Content

The results as presented in Table 3 shows that sample C (unsulphited sun dried) tomato powder had the highest increase in the calcium (59 mg/100g), sodium (69 mg/100g), potassium (75 mg/100g), iron (28 mg/100g), magnesium (9.0 mg /100g) and phosphorus (4.45 mg/100g). This result shows that calcium was retained in sun dried unsulphited sample compare with other sample. Calcium is vital element for building strong bones and teeth, it deficiency cause osteoporosis, which causes bone to beak easily. Iron helps red blood cells in carrying oxygen to all parts of the body, its deficiency cause anemia, which leads to weakness (Salumkhe, *et al.* 1991). The lowest of sodium (65.00 mg/100g), potassium (69.00 mg/100g), iron (2.38 mg/100g), magnesium (8.00 mg/100g) and phosphorus 41.00 mg/100g) was observed in sample B (sulphited oven dried sample). The result depicts that addition of sulphite to the samples led to slight reduction in sodium availability.

Sample	**Ca+**	**Na^+**	**K^+**	**Fe^+**	**Mg^{++}**	**PO_4**
O	31.00^a	45.00^a	30.00^a	0.80^a	4.50^a	28.00^a
A	$54\ .50^c$	67.50^d	71.00^c	2.50^c	8.75^d	42.00^d
B	55.00^c	65.00^b	69.00^b	2.38^b	8.00^b	41.00^b
C	59.00^d	69.00^e	75.00^e	2.80^e	8.75^d	44.50^e
D	52.00^b	66.00^c	72.00^d	2.60^d	8.25^c	43.00^c

Table 3: [1,2]Effect of drying methods and pretreatments on the mineral content (mg/100g)

[1] Means of three replicate [2]Means with the same letters for a particular measurement are not significantly different ($p\leq0.05$).

O = Fresh tomato

A = Sulphited sun dried

B = Sulphited oven dried

C = Unsulphited sun dried

D = Unsulphited oven dried

The unsulphited sample recorded has greater value as compared to the sulphited sample. Statistical analysis shows that the drying method and pretreatment has significant effect (P<0.05) on calcium, sodium, potassium, iron, magnesium and phosphorus of tomato powder (Table 4).

		Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Calcium	Between Groups	2502.7	5	500.5	572.0	0.0
	Within Groups	10.5	12	0.9		
	Total	**2513.1**	**17**			
Sodium	Between Groups	2226.6	5	445.3	508.9	0.0
	Within Groups	10.5	12	0.9		
	Total	**2237.1**	**17**			
Potassium	Between Groups	7372.5	5	1474.5	1474.5	0.0
	Within Groups	12.0	12	1.0		
	Total	**7384.5**	**17**			
Iron	Between Groups	13.6	5	2.7	322.6	0.0
	Within Groups	0.1	12	0.0		
	Total	**13.7**	**17**			
Magnesium	Between Groups	70.0	5	14.0	2241.0	0.0
	Within Groups	0.1	12	0.0		
	Total	**70.1**	**17**			
Phosphorus	Between Groups	1073.6	5	214.7	245.4	0.0
	Within Groups	10.5	12	0.9		
	Total	**1084.2**	**17**			

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

4.Conclusion

It can be concluded that the method of drying used and pretreatment has significant effects on the moisture, ash, crude fiber, pH and mineral content of tomatoes. It however does not have effects on the total sugar content of tomatoes. The unsulphited sun dried samples had the highest increase in calcium, sodium, potassium, iron, magnesium, phosphorus. It is therefore recommended that sun drying method without the use of pretreatment will be most suitable for tomato drying in terms of retained nutritional and mineral content.

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