Arid Zone Journal of Engineering, Technology and Environment. August, 2013; Vol. 9: 1-7

Print ISSN: 1596-2490, Electronic ISSN: 2545-5818
www.azojete.com.ng

QUALITY ASSESSMENT OF SOLAR ENERGY DRIED TOMATO FLAKES

Isiaka M.

(*Department of Agricultural Engineering, Institute for Agricultural Research, Ahmadu Bello University, Zaria, Nigeria*)

Abstract

This study was carried out to assess the quality of solar dried tomato flakes by determining its safety, nutritive value and wholesomeness. In order to determine the safety of the dried tomato, the bacteria and mould loads were determined using three sliced thicknesses of solar energy dried samples. Two different types of *agar* culture media were used to culture the released bacteria and mould cells. Ascorbic acid and proximate tests were carried out to determine the nutritional value of the dried product as compared with the fresh products. To determine the wholesomeness of the dried product, the organoleptic properties in terms of colour (appearance) and taste (flavour) were examined and compared with those of three other tomato products. Results showed that the mean viable bacteria count ranged from 9 to 13 colonies/ml with the 25 mm thickness giving the highest value, followed by 20 mm thickness and the least value was from 15 mm thickness. The same pattern was observed for mould infection. The infection range for the three slice thicknesses was within the recommended safe limit of ≤30 colony forming unit/ml for bacteria and mould counts in food products. There was substantial drop in ascorbic acid content from 28.2 mg/100 g for fresh ripe tomato to as low as 13.6 mg/100 g for dried tomato of 25 mm slice thickness and highest value of 20.6 mg/100 g for 20 mm thickness. The results for organoleptic properties showed the tomato dried by solar energy dryer is superior to the other tomato products.

Keywords: dried tomato flakes, safety, nutritive value and wholesomeness.

1. Introduction

Tomato, *Lycopersicon esculentum*, is an important vegetable for human use because of its vitamins and minerals content that provide the basic body nutritional requirements (Lorenz and Maynard, 1997). According to Splittstoesser (1990), it is ranked 14th among sixteen common vegetables (spinach, lima beans, peas, sweet potato, carrots, cabbage, lettuce, onion, etc) based on total nutritional concentration but ranked first based on the contribution of nutrients to the diet. The level of production of this basic crop has increased in almost all the *fadama* or irrigated areas of Northern Nigeria. However, with this increase in production level, post-harvest deterioration and subsequent losses has been a major setback especially at peak period of harvest. At this crucial period, the price value of the product normally drops to low levels (below production cost) and in most cases wastage due to deterioration of the product that takes place. The scenario has created opportunity for many unskilled processors to mop up some of the excesses for drying. The exercise is normally carried-out with little consideration for the final quality of the product being dried (Isiaka et al., 2011). Due to the seasonal nature of the crop, these poorly dried products have ready-made market during the off season when the products are scarce. Research efforts at Institute for Agricultural Research, Samaru - Nigeria has resulted in development of low energy demanding forced convection solar energy dryer for tomato and other vegetables crops (Isiaka et al., 2011). Impressive performance in terms of drying efficiencies has been reported for the dryer (Isiaka et al., 2011). However, drying efficiencies may not be adequate in qualifying this dryer for

acceptance, except when the quality of the dried product is comparable to other alternatives in terms of safety, nutritional value and organoleptic properties. Food safety is a major factor in quality measurement. Consumption of food which does not meet minimum safety standards can jeopardize human survival (WHO, 1998). It is, therefore, the objective of this work to carryout quality assessment of solar dried tomato by determining its safety, nutritive value and wholesomeness. The quality parameters considered were total bacteria and mould loads; nutritional contents; and organoleptic properties of the dried products.

2. Materials and methods

2.1 Total bacterial and mould loads

To determine the safety of the dried tomato, the bacteria and the mould loads were determined in the Department of Microbiology, Ahmadu Bello University, Zaria. In carrying out these tests, three sliced thicknesses of tomato were dried in solar energy dryer and the dried samples were used. Three samples from each of the sliced thicknesses were thoroughly mixed in separate containers. Thereafter, 10 g was weighed from each thickness, stored in sterilized containers and kept in a refrigerator until needed for the tests.

The samples were macerated by mixing 10g of each sample with 9 ml of sterilized peptone water to release bacterial and fungus cells. Two different types of *agar* culture media were used to culture the released bacteria and mould cells. They were plate count *agar* (PCA) and potato dextrox *agar* (PDA). The former was used to culture bacteria while the later was used to culture mould infections. The culture media, for each thickness, was serially diluted to five population densities (10^{-1}, 10^{-2}, 10^{-3}, 10^{-4} and 10^{-5} CFU/mil) in sterilized peptone water. Thereafter, 0.1 ml of each of the dilution was surface plated in duplicate. For bacteria count, 10^{-4} and 10^{-5} were plated out while 10^{-2} and 10^{-3} were plated out for mould. The inoculated plates for bacteria were incubated for 48 hours while that for mould were incubated or kept in locker for 72 hours (Downes and Ito, 2001; FDA, 2005). At the end of the incubation period, the colonies were counted for both samples using laser colony counter.

2.2 Ascorbic acid and nutritional contents

Ascorbic acid and proximate tests were carried out to determine the nutritional value of the dried product as compared with the fresh products. The tests were carried out in Food Science and Technology Programme Research Laboratory, Institute for Agricultural Research, Ahmadu Bello University, Zaria.

2.3 Organoleptic properties

To determine the wholesomeness of dried tomatoes, the organoleptic properties in terms of colour (appearance) and taste (flavour) were examined. These two properties are quality attributes which play important roles in food acceptability. In this test, four tomato products were compared for their qualities and these were: fresh tomato as

reference or standard, solar energy dried tomato, locally dried tomato in open sun, and canned tomato. Samples were prepared into paste and the same quantity of each was measured out. Other ingredients (peppers, onion, meat, groundnut oil, etc) were applied equally in preparing the products into stews. The assessment was done using Multiple Comparison Tests. In this, nine panellists were used to compare the four samples (coded) using structured questionnaire. The results of the tests were statistically analysed.

3. Results and discussion

3.1 Total bacterial and mould loads

Table 1 shows the test results for microbial loads of the three different thicknesses of the dried samples. From the results, the mean viable bacteria count ranged from 9 to 13 colonies/ml with the 25 mm thickness having the highest value. This was closely followed by the 20 mm thickness and the least value was obtained from 15 mm thickness. The 25 mm thickness also gave the highest value of colony/ml for mould infestation, followed by the 20 mm and the least colony/ml again was from 15 mm. The differences in the observed values may be attributed to level of moisture in the samples. The 25 mm thickness had more moisture available and the drying process was equally slow. These conditions favoured microbial activities. In the 15 mm thickness, available moisture for evaporation was less and heat absorption was at the highest level resulting in lesser drying time. That is, low moisture, high temperature and shorter drying time retarded the activities of bacteria and moulds. The results tallied with the physical appearance of the dried products where the 15 mm slices showed a very bright colour as compared with 25 mm slices whose colour appeared dark. However, the infestation range for the three slice thicknesses was within the recommended safe limit of $\leq$30 colony forming unit/ml (Downes and Ito, 2001; FDA, 2005) for bacteria and mould counts in food products.

Table 1 Mean microbial load and ascorbic acid content of dried tomato samples

Quality parameter	Slice thickness			
	15mm	20mm	25mm	Fresh
Bacteria count *(Colony/ml)*	09	10	13	-
Mould count *(Colony/ml)*	06	07	08	-
Ascorbic acid *(mg/100g)*	17.08	20.60	13.56	28.15

3.2 Ascorbic acid and nutritional contents

The results for ascorbic acid content are as shown in Table 1. It is evident from the results that there was substantial drop in ascorbic acid content from 28.2mg/100g for fresh ripe tomato to as low as 13.6mg/100g for dried tomato of 25mm slice thickness. The highest value obtained for the dried sample was 20.6mg/100g from 20mm thickness. The lower level of ascorbic acid content in 25 mm thickness may be attributed to

oxidation and leaching (Njoku *et al.* 2011) as a result of high moisture and low rate of drying as compared with other thicknesses. Also, the highest level of temperature experienced by the 15 mm thickness could have affected the ascorbic acid content (Njoku *et al.* 2011). From these results, it can be concluded that 20mm slice thickness had the best quality attributes in terms of low microbial load and high ascorbic acid content.

The results for nutritional contents as determined by proximate analysis of the dried tomato samples from solar energy dryer are as presented in Table 2. Mean values of 2.03%, 1.02% and 1.41% were recorded for protein, ash and fibre contents, respectively. Others are; 71.8 and 0.98% for CHO and lipid contents, respectively.

Table 2 Proximate results of dried tomato samples

Replicate	Nutritional content (%)				
	Protein	Ash	Fibre	CHO	Lipid
1	2.16	1.06	1.46	71.56	1.06
2	1.98	0.94	1.48	72.04	0.86
3	1.94	1.06	1.28	71.86	1.02
Mean	**2.03**	**1.02**	**1.41**	**71.82**	**0.98**

3.3 Organoleptic properties

The analysis of variance results for organoleptic properties (taste and colour) from 15 member panellists are as presented in Tables 3 and 4. The results in Table 3 show that the difference in mean values for judges was not statistically significant at 99% probability level but the difference in means for samples was highly significant at 95% probability level. This implies that there was high variation in samples' taste. The significant factor was further analysed using Duncan Multiple Range Test (DMRT) as shown in Table 5. From the result, there was difference in taste between the following pairs of samples: sample B and D, sample D and C, and sample C and A. That is, the taste of sample B was more preferable than that of sample D, that of sample D was more preferable than that of sample C, and sample C more preferable than sample A. In essence, the taste of the tomato dried by solar energy dryer was superior to the other tomato products examined. The next in ranking was open sun dried sample, followed by canned tomato, and the least was fresh tomato which had sour taste.

Table 3 Analysis of variance (ANOVA) for taste test

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F
Samples(S)	3	134.85	44.95	121.49**
Judges(J)	14	12.33	0.88	2.38
Error	42	15.4	0.37	
Total	59	162.58		

** - Significant at 95% probability level

Table 4 Analysis of variance (ANOVA) for colour test

Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F
Samples(S)	3	82.18	27.39	210.69**
Judges(J)	14	5.5	0.39	3.00
Error	42	5.57	0.13	
Total	59	93.25		

** - Significant at 95% probability level

Table 5 Duncan's Multiple Range Test (DMRT) for Taste comparison

Treatment	**Score**	**DMRT**
B	6.13	a
D	5.13	b
C	4.33	c
A	2.07	d

SE = 0.157 [A = canned tomato, B = solar dryer tomato, C = fresh tomato and D = open sun dried tomato]

The analysis of variance for colour test, as presented in Table 4, reveals that there was also no significant difference in means, at 99% probability level, for judges. However, in the case of the samples, the difference in means was highly significant at 95% probability level. Further analysis using DMRT, as presented in Table 6, shows that there was difference in means between the following pairs of samples: samples C and

B, samples B and A, and samples A and D. The fresh tomato was ranked the best, having a bright colour when compared with the other samples. This was followed by tomato dried by solar energy dryer and the open sun dried samples. The least in colour was the canned tomato which had dull appearance. This implies that, the appearance (colour) of the fresh tomato is superior in quality when compared with the other samples.

From these results, as obtained from 15 members' panel of judges, it can be concluded that the quality of the dried tomato product from solar energy dryer is high and even superior to other tomato products in terms of taste, and the colour was also better when compared with canned and open sun dried products.

Table 6 Duncan's Multiple Range Test (DMRT) for Colour comparison

Treatment	Score	DMRT
C	4.33	a
B	3.27	b
A	2.20	c
D	1.20	d

SE = 0.093 [A = canned tomato, B = solar dryer tomato, C = fresh tomato and D = open sun dried tomato]

4. Conclusions

From the results obtained from the study, the following can be concluded:

1. The bacteria and mould counts, for all the thicknesses examined, were within the recommended safe limit and therefore safe for human consumption.
2. 15 mm slice thickness had the best quality attributes in terms of moderate microbial and mould loads, and high ascorbic acid.
3. There was substantial drop in ascorbic acid content from 28.2 mg/100 g for fresh ripe tomato to as low as 13.6 mg/100 g for 25 mm slice thickness and highest value of 20.6 mg/100 g for 20 mm thickness.
4. The results for organoleptic properties showed that the taste of the tomato dried by solar energy dryer was superior to other tomato products examine, at 95 percent probability level.

References

Downes, FP. and Ito, K. 2001. Compendium of Methods for the Microbiological Examination of Foods. 4th Ed., American Public Health Association (APHA). Washington, D. C.

FDA 2005. Bacteriological Analytical Manual. 18th Ed., AOAC, Washington, D. C.

Isiaka, M., El-Okene, AMI., Mudiare, OJ. and Yusuf, DD. 2011. Development of low energy forced convection solar energy dryer for sliced tomato. Proceedings of the International Conference of the Nigerian Institution of Agricultural Engineers. **32**: 601 - 608.

Lorenz, OA. and Maynard, DN. 1997. Knott's Handbook for Vegetable Growers. 3rd Edition, pp 23-38 and 341- 342.. John Wiley and sons. New York.

Njoku, PC., Ayuk, AA. and Okoye, CV. 2011. Temperature effects on vitamin C content in citrus fruits. Pakistan Journal of Nutrition, **10**(12): 1168 – 1169.

Oranusi, SU., Oguoma, OI. and Agusi, E. 2013. Microbiological quality assessment of foods sold in student's cafeterias. Global Research Journal of Microbiology, **3**(1):1 – 7.

Splittstoesser, WE. 1990. Vegetable Growing Handbook: Organic and Traditional Methods. 3rd Edition, pp 167-171. Vannostrand Reinbold, New York.

WHO 1998. Food Safety- a world-wide public health issue. Internet WHO Homepage **http// www.who.ch/.**