INVESTIGATION OF THERMAL RETENTION IN CARROT AND TOMATO JUICE SERVING AS PRESERVATIVE IN FOOD PROCESSING

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Abstract

Consumer interest in health and wellness prompted the food industry to develop alternative processing technological solutions for preserving food. As such, the level of heat retention in both and combined food processing were measured at room temperature, at interval of five (5mins) for heating and one (1min) for cooling of various samples. Classical method was used, taken all readings with thermometer. Heat treatment does not affect phenolic content and the calcium (Ca) cross linking in the polysaccharides cell wall of the food generally. This provide a helpful tool for understanding the longer at which food can be preserved in combination state (carrot and tomato) for a broader industrial and domestic relevance. This research paper provides scientific evidence for heat retention during thermal treatment, as it could serve as preservative in food processing.

Keywords: Carrot, Food Processing, Heat Absorption, Preservative, Tomato

Introduction

In recent years increasing attention has been paid to the role of heat retention as a function of food preservative and compounds responsible for that, particularly are of natural origin and in order to extend the shelf life of food products, they are usually treated thermally using methods such as hot water immersion.. For these reason, information on the overall heat changes on combine food processing is becoming relevant in the field of food technology.

Tomato *(Lycopersicon esculentum Mill.)* belongs to the family *Solanaceaa* is grown in many parts of Nigeria and most production is at a small scale in back yard gardens, there are a few commercial fields (Wokoma, 2008). Its centre of origin is presumed to be in the present state of Mexico (Heiser, 1969). Thermal treatment is generally believed to be the main cause of the depletion in natural antioxidants (Liao, 1988; Jonsson, 1991). On the other hand, heating can also induce the formation of further compounds with antioxidant (Maloki, 1973; Rizzi, 1994) which serve as food preservative. However, (Monica et al., 1999) indicates that after an initial decrease observed for 2hrs heated sample of tomatoes recovery of the original antioxidant potential can be achieved by prolonging the heating time, concluded that heating cause an increase in the overall antioxidant potentials of the tomato juice. Thus, stability and shelf life of tomatoes derivatives or food product containing tomato as an ingredient are expected to be improved when prolonged thermal treatment are applied. (Monica et al., 1999).

Carrot, (*Daucus carota L*.) is one of the most important cool season root vegetables grown extensively in various countries particularly Nigeria. The carrot is a good source of natural antioxidant especially carotenoids and phenolic compounds (Chantaro and Chiewchan, 2008). Carrot juices are preferable used as a natural source of pro vitamin A in the production of *alphatocopherol-beta*-carotene drinks (ATBC-drink) leading to superior physical and chemical stabbility(Carle, 1999; Marx, Schieber, & Carle, 2000). Furthermore, because of the high antioxidant activity, coloring food with carrot juice is healthy as it may provide health benefits against chronic and life style disease (Khandare et al., 2011). While many authors have assessed the effect of thermal processing on the nutritional properties of food, such as antioxidants capacity (Galotto et al., 2008), some attempted to link their studies with quality measurement such as instrumental color analyses, other studies have dealt with the kinetic and mechanism of thermally induced isomerization β- carotene.. This present study was to assess the effect of thermal retention in both individuals and combination of carrot and tomato juice as it could serve as preservative in food processing and shelf-life.

Material and Method

Preparation of the juice (Tomato and carrot).

Both Carrot *(Daucus carota L)* and Tomato *(Lycopersicon esculentum Mill)* were obtained from Okene Central Market, Kogi State, after washing and dicing samples were blended in an electrical blender. Samples were packed and set for thermal treatment.

Heat treatment

The packed sample were weighed into 12.5kg each for various sample which include Fresh carrot Juice (FCT), Fresh tomato Juice (FTM), Soup sample (SS), Mixture of fresh carrot and fresh tomato (FCT, FTM), mixture of fresh carrot and Soup sample (FCT, SS) and mixture of boil carrot and soup sample (BC, SS). Each weighed sample on comparison were boiled in water using beaker for interval of 5min. thermometer readings were recorder for both heating and cooling. After thermal treatment samples under comparison were removed and cooled at room temperature.

Result

Temperature changes during heating (absorption).

Table 1a

s/no	Time (t) (min)	0^oC FCT JUICE	0^oC FTM JUICE
1	1	37	38
2	5	51	51
3	10	62	61
4	15	71	72
5	20	79	78
6	25	83	84
7	30	87	86

From Table 1a and Graph 1a, fresh carrot juice (FCT) gain higher heat than fresh tomatoes juice (FTM). This may be indicative of it Ca-cross-linkage.

Graph 1a

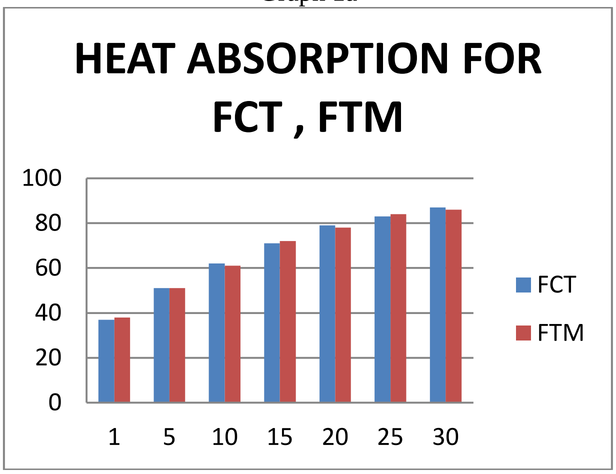


Table 2a

s/no	Time (t) (min)	0^oC FCT JUICE	0^oC FCT& FTM
1	1	37	39
2	5	51	50
3	10	62	64
4	15	71	74
5	20	79	82
6	25	83	84
7	30	87	89

Graph 2a

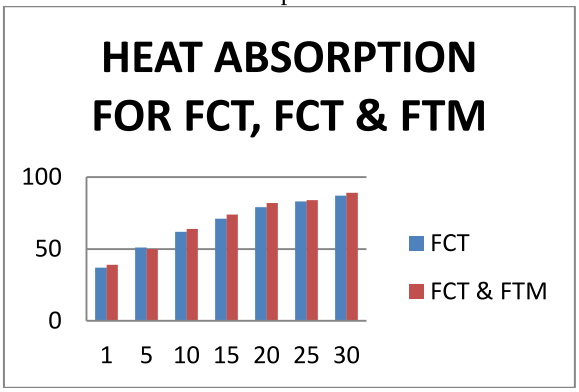


Table 2a with graph 2a shows that the combined heat treatment of FCT & FTM has higher heat absorption. This may be indicative of combine caratenoid in both plant.

Table 3a

s/no	Time (t) (min)	0^oCFCT JUICE	0^oC FCT & SS
1	1	37	35
2	5	51	44
3	10	62	52
4	15	71	62
5	20	79	72
6	25	83	82
7	30	87	93

Table 3a with graph 3a shows that the presence of FCT in SS help in better heat absorption compared to FCT alone.

Graph 3a

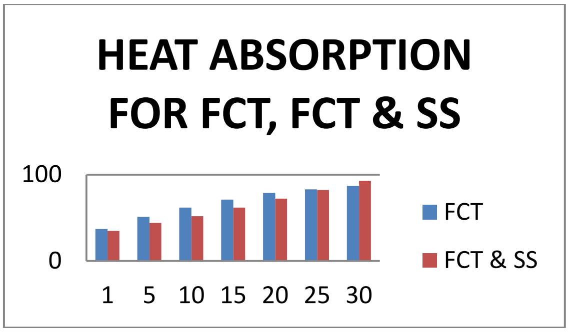


Table 4a

s/no	Time (t) (min)	0^oC FCT JUICE	0^oC FTM JUICE	0^oC FCT & SS
1	1	37	38	35
2	5	51	51	44
3	10	62	61	52
4	15	71	72	62
5	20	79	78	72
6	25	83	84	82
7	30	87	86	93

Table 4a with graph 4b shows that combined treatment absorption compared to both FCT and FTM.

Graph 4a

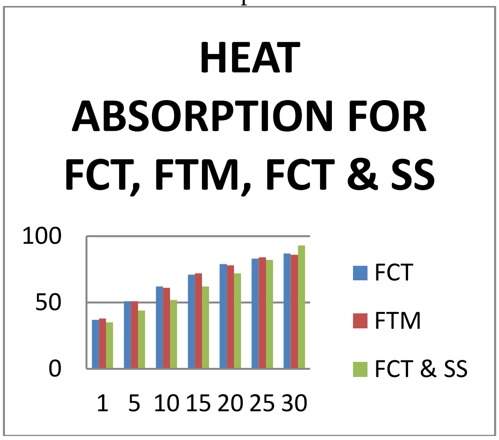
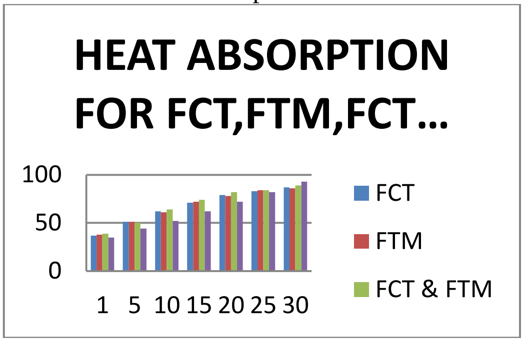


Table 5a

s/no	Time (t) (min)	0^oC FCT JUICE	0^oC FTM JUICE	0^oC FCT & FTM	0^oC FCT & SS
1	1	37	38	39	35
2	5	51	51	50	44
3	10	62	61	64	52
4	15	71	72	74	62
5	20	79	78	82	72
6	25	83	84	84	82
7	30	87	86	89	93

Table 5a with graph 5a clearly distinguished between sample containing FCT at higher absorption to the sample without FTM in both FCT and SS and FCT and FTM has better absorption.

Graph 5a



Temperature Changes during Cooling (Retention)

Table 1b

s/no	0^oC FCT JUICE	0^oC FTM JUICE
1	61	45
2	49	39
3	42	37
4	38	35
5	37	35
6	36	35
7	36	35

Table 1b and graph 1b showed that both FCT and SS and FCT and FTM retain heat longer time (7 minutes) compared to FTM and FCT.

Graph 1b

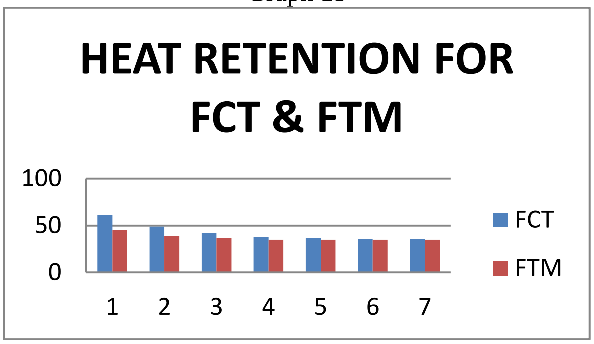


Table 2b

Time (t) (min)	0^oC FCT JUICE	0^oC FCT & FTM
1	61	50
2	49	41
3	42	38
4	38	37
5	37	37
6	36	37
7	36	37

Table 2b and graph 2b showed that combined FCT and FTM retain heat than FCT alone during thermal treatment.

Graph 2b

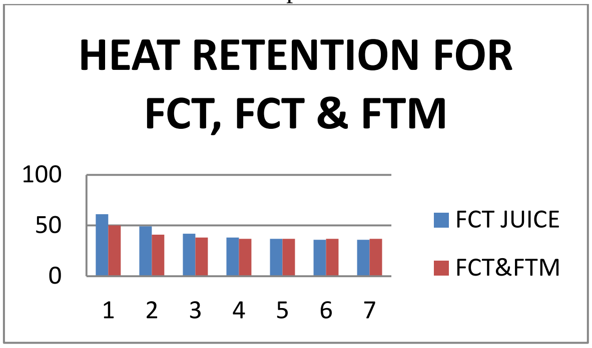


Table 3b

Time (t) (min)	0^oC FCT JUICE	0^oC FCT & SS
1	61	70
2	49	55
3	42	45
4	38	39
5	37	38
6	36	37
7	36	37

Table 3b and graph 3b clearly show that the presence of FCT in sample as in FCT and SS retain heat compared to FCT.

Graph 3b

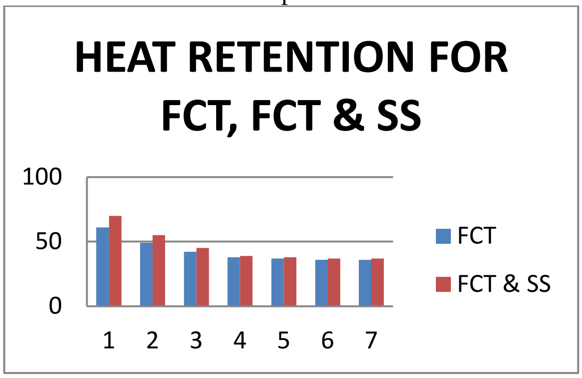


Table 4b and graph 4b showed that the addition of FCT to SS as in FCT and SS retain more heat than its individual sample i.e. FTM and FCT.

Table 4b

Time (t) (min)	0^oC FTM JUICE	0^oC FCT JUICE	0^oC FCT & SS
1	45	61	70
2	39	49	55
3	37	42	45
4	35	38	39
5	35	37	38
6	35	36	37
7	35	36	37

Table 4b and graph 4b showed that the addition of FCT to SS as in FCT & SS retain more heat than its individual sample i.e. FTM & FCT

Graph 4b

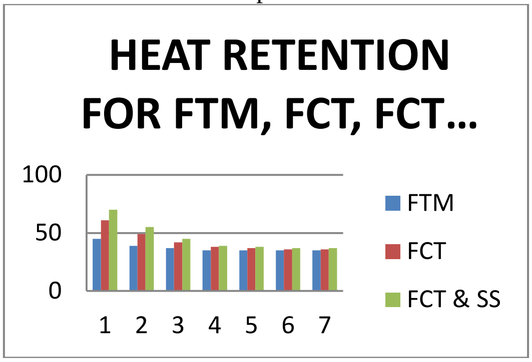


Table 5b

s/no	Time (t)(min)	0^oC FCT JUICE	0^oC FTM JUICE	0^oC FCT & FTM	0^oC FCT& SS
1	1	61	45	50	70
2	2	49	39	41	55
3	3	42	37	38	45
4	4	38	35	37	39
5	5	37	35	37	38
6	6	36	35	37	37
7	7	36	35	37	37

Graph 5b

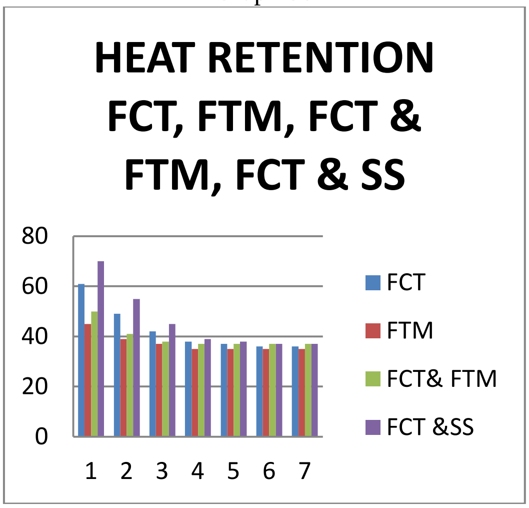


Table 5b and graph 5b: showed clearly that FCT has addition component for heat retention

Discussion

From Table (2a) and (2b) FCT and FM absorbed heat at 89^0C and also retain heat at 37^0C for 67 minutes. While, in Table (3a) and (3b) clearly shows that FCT and SS absorbed heat at 93^0C and also retain it heat for longer time at 37^0C. Both table (2a) and (3a) show the presence of FCT as a factor of heat retention in food processing. This factor could be held by either maturation of carrot, polymer integrity and cross linking or the presence of antioxidant compounds. However, Table (4a) and (4b) has justify FCT to be a good additive as it maintains it heats absorption and retention in various sample. Meanwhile, from Table 5a and 5b, the overall investigation is clear as to the presence of FCT in Samples of FCT and SS and FCT and FTM showed the absorption and retention is achieved at higher temperature in all samples (89^0C and 93^0C) but still at longer time (7 minutes). Higher redness was observed immediately after milling as compared to a significant physical decrease in color intensity after thermal treatment of carrot juice. This may be due to better extractability of caratonoid as good grinding is encourage since caratonoid are the major pigment.

Carrot has calcium cross linking polysaccharides, cell-wall polymers integrity and cross-linkage such as simple phenolics have important implication in mechanical properties, involving cell-cell adhesion (Waldon et al., 1997; Parr et al., 1977) and the rate of antioxidant as Damin et al., 2012 stated that the anti-radical (antioxidant) activity of the thermally treated sample was a little higher than for the untreated pure sample is a supportive evidences for it thermal stability. While the fresh tomato absorbs heat least but has higher heat retention (35^0C) for longer time. This is because of heating induced tissue softening vegetables as it accompanied with dissolution of pectic polymer through β-elimination degradation (Brett and Waldrim, 1996).

Conclusion

While increases in antioxidant content as noted for carrot and tomato juice (natural phenolic component is most crucial for heat retention) and the presence of calcium cross-linking of pectic polysaccharides, the boil and fresh carrot juice is justified as a good additive to food preparation as it enhance preservative

APPENDIX I: Proposed uses and use levels of tomato extract (expressed as lycopene level added to food)

Food category	Gsf a food category and food-use	Use level (mg/kg)
Milk products	0.1.1.2 flavoured milk and milk	30
	01.2.1 Fermented milk beverages	30
	13.4 Milk-based meal replacements	9-40
Dairy Product Analogues	01.3.3 Imitation milks	30
	01.5 Dry Milk	30
	01.5.2 Soy Milks	30
	01.7 Yoghurt	20-40
	01.7 Frozen Yoghurt	20-40
Fats and Oils	02.2.1.2 Margarine-like spreads	20
Soft Candy	05.2 Chewy and nougat candy	15

	05.2 Fruit Snacks	15
Hard Candy	05.2 Hard Candy	20-70
Chewing Gum	05.3 Chewing gum	15
Breakfast Cereals	06.3 Ready-to-eat cereals	30-130
	06.5 Instant and regular hot cereals	9-20
	07.1.2 Crackers and crisp breads	60
	07.2.1 Cakes, Cookies	30
Egg products	10.4 Egg-based desserts	20
Soups and Soup Mixes	12.5.1 Soups	30
	12.6.1 Salad dressings	30
Gravies and Sauces	12.6.2 Tomato-based sauces	30
	12.9.1.1 Soybean beverage	20-40
Beverages and Beverage Bases	14.1.1.1 Bottled Water	2-15
Processed Fruits and Fruit Juices	14.1.2.1 Fruit juice	4-20
	14.1.2.2 Vegetable Juice	4-20
	14.1.3 Nectars	4-20
	14.1.4 Energy, sport and isotonic drinks	4-15
	14.1.4.1 Carbonated beverages	4-20
	14.1.4.2 Fruit-flavoured drinks	9-15
	14.1.5 Tea, ready-to-drink	3-15
Baked Goods and Baking Mixes	15.1 Cereal and energy bars	40-80

* Food category system of the General Standard for Food Additives (GSFA) of the Codex Alimentarius Commission (FAO/WHO, 2009. Food Category system. In: General Standars for Food Additives CODEX STAN 192-1995 (Rev. 10-2009), Annex B, pp. 9-48. Food and Agriculture Organization of the United Nations (FAO), Rome, and the World Health Organization (WHO), General). Available at: http://www.codexalimentarius.net/web/standard.list.do?land=en (Accessed 14 September, 2009).

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