Effect of stabilizers, drying and storage on various desirable qualities attributes of watermelon rind candy

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Abstract

The present study investigated the influence of different treatments on various desirable quality attributes of watermelon rind based candy. Four different samples of candy were prepared by using different levels of citric acid and pectin in the ratio of 0%, 1:1%, 1:1.5%, 1.5:1.5% respectively. Then packed in LDPE pouches and stored under ambient conditions for about two months. Results showed increase in acidity from 0.30-0.64%, ascorbic acid content 4.11-4.59, reducing sugar 29.64-34.96%, L* value 41.86-53.80, a* value 1.51-2.74 and hardness 79-96 N with increase in concentration of citric acid and pectin respectively. While as pH value decreased from 5.74-5.25, TSS from 76.14-68.05, aw from 0.732-0.697 respectively. From the present study it can be concluded that watermelon rind based candy supplemented with 1.5% pectin and 1.5% citric acid was found to have an excellent quality characteristics compared to control samples. Further it can be concluded that drying period of 18 h was found most appropriate for drying watermelon rind based candy.

Keywords: Acidity, Ascorbic acid, Reducing sugar, LDPE, Drying, Watermelon.

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Introduction

Candy is a sweet food prepared from fruits or vegetables by using osmotic dehydration process that involves slow impregnating of sugar syrup by draining excessive syrup and then drying the product to a shelf stable state [1]**.** Being an important food preservation technique foods especially fruits and vegetables are immersed in the osmotic solution containing concentrated salt, sugar, alcohol or starch. Fructose, corn syrup, glucose, sodium chloride or sucrose can be used as osmotic agents. To produce shelf stable product it is necessary to reduce the water content in candy.

Watermelon, *Citrullus lanatus* (Thunb.) belongs to family *Cucurbitacea* is a large, oval, round or oblong tropical fruit which grows in almost all parts of Africa and South East Asia [2]**.** Its biomass can be categorized into three main components i.e, flesh, seed and rind. Flesh represents approximately 68%, rind 30%, and seeds about 2% of total weight. Red flesh of watermelon present inside is sweet, edible and used for juices and salads but the outer rind is considered as waste and has no commercial value. Watermelon rind (WMR) consists of pectin, cellulose, proteins and carotenoids which are rich in functional groups such as hydroxyl (cellulose) and carboxylic (pectin) [2-4]. Rind is also rich source of potassium and non-essential amino acid-citrulline. It has potential antioxidant and vasodilation roles and is vital to heart, circulatory system and immune system [2]**.** Usually rind is discarded and applied to feeds or fertilizers but they are also edible and sometimes used as a vegetable. Due to its high water content about 95%, it is more susceptible to deterioration [5]**.** Therefore, it is necessary to reduce the moisture content and produce shelf stable products from watermelon rind like candies and preserves. Keeping in view the above mentioned nutritional facts of watermelon rind, the present study aimed to develop rind based functional candy and to study the quality characteristics of developed functional candy.

MATERIALS AND METHODS

Raw materials

Watermelon, cane sugar, citric acid, pectin, was procured from the local market of awantipora. Three *Citrullus lanatus* weighing 3 kg each free from transportation injuries, bruises, insect damage and diseases were used. The rind part was separated by edible part with knife. About 4 kg rind was further used for preparation of candy.

Preparation of watermelon rind candy

The watermelons were subjected to the procedure of selection, washing and rind separation from the edible part and seeds. Only the rinds were used to develop the candies, while the flesh was discarded. The green layer of rinds were removed and the remaining white flesh was diced in cubes of approximately 2 cm each side and blanched in boiling water for 1 minute. The blanched rind cubes were dipped in sugar syrup prepared by using sugar, different levels of citric acid and pectin (Table 1) for 24 h at 40° Brix TSS. Then the rind cubes were removed from the syrup and consistency of syrup was increased to 55° Brix by boiling. The rind cubes were steeped in 55° Brix syrup and left to stand for another 24 h. Then the process was repeated to raise the strength of syrup 55° Brix to 65° Brix and finally

Table 1. *Proximate composition of watermelon rind.*

Parameter	Watermelon rind
Rind weight	1000 g
Peel weight	550 g
Moisture (%)	14.73 ± 0.01
Ash (%)	3.90 ± 0.03
Fat (%)	3.84 ± 0.02
Protein (%)	3.66 ± 0.02
Crude fibre (%)	15.02 ± 0.25
Carbohydrate (%)	58.84 ± 0.03
Ascorbic acid (mg/100 g)	6.5 ± 0.25
pH	6.34 ± 0.02
TSS (°Brix)	5.8 ± 0.36
Acidity (%)	0.41 ± 0.03
Total sugars	4.8 ± 0.2
Reducing sugars	2.1 ± 0.35
Water activity	0.671 ± 0.002
*L**	57.57 ± 0.03
*a**	3.04 ± 0.02
*b**	29.24 ± 0.02
**Values are means of three replications ± standard deviation.*	

to 75° Brix. Every time an increase in sugar concentration was made, the syrup was drained, heated and sugar was added to bring the total soluble solids up to the desired level. The hot syrup was cooled to 60°C before adding to the rinds. At the final syrup concentration, the rinds were kept for 3 days and drained. Then the rind samples were arranged on stainless steel perforated tray before drying in a hot air dryer at temperature of 50°C for 14, 16, 18 h respectively. The watermelon rind candies were then packed in LDPE pouches and stored under ambient condition 27 ± 2°C for 2 months. The samples were then analysed after every 15 days.

Physico-chemical analysis of watermelon rind based candy

The percentage moisture, fat, protein content of watermelon rind candy were determined as per AACC [6].

pH

pH was determined by using digital pH meter (Model ME-912, MAX electronics (India). The pH meter was first calibrated using buffers of pH 4.0 and 7.0 at room temperature. The sample was then taken in 100 ml beaker, stirred and electrode of pH meter put in it and direct reading from pH meter was taken when the reading stabilized.

Titrable acidity

Known weight of sample was boiled for 30 minutes with small quantity of distilled water, loss of water during evaporation was made up by addition of distilled water. The solution was filtered through Whatman No.4 filter paper and volume was made up to 100 ml. with previously boiled distilled water. A known aliquot of the above extract was titrated against standard 0.1 N NaOH using phenolphthalein as indicator and acidity was calculated as:

$$\text{Titrable acidity}(\%) = \frac{\text{Titre value} \times \text{Normality NaoH} \times \text{vol. make up} \times \text{equivalent weight of acid} \times 100}{\text{Weight of sample taken for estimation} \times \text{vol. of alliquot taken} \times 1000}$$

Ascorbic acid content

Ascorbic acid content of watermelon rind candy was determined by using the method developed by Ranganna [7]**.** For ascorbic acid determination 5 ml standard ascorbic acid solution was added with 5 ml of metaphosphoric acid (HPO_3) and titrated with the dye solution (2, 6-dicholrophenol indophenol) until pink colour appeared, which persisted for 15 seconds. Afterwards 10-20 ml of sample was taken and made up to 100 ml with 3% metaphosphoric acid (HPO_3) and then filtered and centrifuged. Later on an aliquot (2-10 ml) of HPO_3 extract of the sample was titrated with the standard dye to a pink end point which persisted for at least 15 seconds.

$$\text{mg of ascorbic acid per 100g} = \frac{\text{Titre Dye factor} \times \text{volume make up}}{\text{Aliquot of extract taken for estimation} \times \text{vol. of sample taken for estimation}} \times 100$$

Total soluble solids (°Brix)

A hand refractometer with range (60-90 °Brix) (Erma, Japan) was used to determine total soluble solids and values were corrected at 20°C [7]**.**

Water activity

Water activity was measured by using a Pre Activity Water Meter Aq No 532.

Sugar

Total sugars were estimated by Lane and Eynon method as described earlier [7]**.** Percentage of total sugars was calculated by using equation as under.

$$\text{Total sugars}\,(\%) = \frac{0.05 \times \text{volume made}}{\text{titre volume x weight of sample}} \times 100$$

Reducing sugars

The filtrate sample was taken in 50 ml burette and titrated against 10 ml mixed fehling A and B solution using methylene blue as an indicator. The end point was indicated by the appearance of brick red colour. The reducing sugar was calculated as:

$$\text{Reducing sugar}\,(\%) = \frac{\text{Mg of invert sugar} \times \text{dilution} \times 100}{\text{titre volume} \times \text{weight of sample} \times 100}$$

Colour analysis of rind candy (L, a*, b* values)*

Colour analysis of Rind Candy was done by using Hunter Lab Colorimeter (12MM Aperture U 59730 Inc., Pittsford, New York, USA). The instrument was calibrated with user supplied black plate calibration standard that was used for zero setting, white calibration plates were used for white calibration settings. The instrument was placed at three different locations with varying rate of exposures. The results obtained were displayed as L*, *a** and *b** color parameters. The *a** value ranges from +100 (redness) to -100 (greeness), the *b** values ranges from -100 (blueness) to + 100 (yellowness) while as L* value indicating the measure of lightness, ranges from 0 (black) to 100 (white).

Texture analysis

Hardness of watermelon based candy was measured using Texture analyzer (TA-XT2., Stable Micro systems, UK) equipped with a knife edge with slotted insert (HDP/Bs) 25 kg load cell. The following settings were used for measuring hardness Pre-test speed 1.5 mm/s, Test speed 2.0 mm/s, Post-test speed 10.0 mm/s.

Statistical analysis

Statistical analysis of the data was carried out using the SPSS (Statistical program for social science) software version 16.0 by 2^2 factorial design.

Proximate analysis of watermelon rind

Proximate composition of fresh watermelon rind is shown in Table 1. Average weight of watermelon rind recorded was 1000 g, while as peel showed 550 g. Moisture content of watermelon rind was found to be 14.73%, ash 3.90% protein 3.66%, fat 3.84%, crude fibre 15.02%, carbohydrate 58.84%. While as ascorbic acid content, acidity, pH, TSS, total sugars, reducing sugars and water activity of water melon rind observed were 6.5 mg/100 g, 0.41%, 6.34, 5.8°Brix, 4.8%, 2.1%, 0.671(aw), Colour evaluation of water melon showed L* value 57.57, *a** value 3.04, and *b** value 29.24.

Effect of treatments, drying and storage on titrable acidity

The data presented in Table 2 shows effect of treatments, drying time and storage periods on titrable acidity of watermelon rind candy. Maximum mean value for acidity 0.64% was recorded for treatment T_3 containing (1.5% citric acid: 1.5% pectin) and minimum value 0.30% was found in treatment T_0 (without any treatment). This increase in acidity value may be due to increased level of citric acid. Results further showed increase in acidity with increase in drying time (14-18 h). Maximum mean acidity value was recorded in DT_{18} 0.54% and minimum value for acidity was found in DT_{14} 0.39%. However, during storage acidity value decreased significantly ($p<0.05$) from 0.75-0.26%. This decrease in acidity during storage may be due to osmotic process which makes water to move out of food into the solution and leach out the natural solutes (organic acid) into the solution and acidity is ultimately reduced.

Effect of treatments, drying and storage on pH

Results presented in Table 3 shows effect of treatments, drying time and storage on percent acidity of watermelon rind candy. Maximum pH value 5.74 was observed for treatment T_0 while as minimum pH value 5.25 was recorded in treatment T_3 (1.5% citric acid: 1.5% pectin). This decrease in pH value from 5.74-5.25 may be due to citric acid because it causes hydrolysis of sucrose. Drying time also showed significant effect on pH as DT_{14} showed pH value of 5.51 and DT_{18} showed pH value of 4.45. This decrease in pH during drying could be due to hydrolysis of sucrose which leads to the production of lactic and formic acid which caused more loss in pH. However increase in pH value from 5.10-6.00 was observed during storage of watermelon rind based candy. Islam *et al.* also reported similar findings for for strawberry jam and jelly [8].

Effect of treatments, drying time and storage on ascorbic acid (mg/100 g)

Results indicated in Table 4 shows effect of treatments, drying time and storage on ascorbic acid content of watermelon rind candy. It was observed ascorbic acid content increased with increase in treatments from 4.11-4.59 (Table 4). However storage period and drying time caused significant decrease ($p<0.05$) ascorbic acid content. As candies dried for longer time DT_{18} had lower ascorbic acid content (2.43 mg/100 g) compared to those dried for DT_{14} contained higher ascorbic acid content (4.16 mg/100 g) at same temperature 50°C. Hasanuzzaman *et al.* also reported decrease in ascorbic acid content in tomato candy, aonla candy and bael preserve [9,10].

Effect of treatments, drying time and storage on TSS°Brix

Results showed decrease in TSS value from 76.14-68.05 of watermelon rind based candy with treatments (Table 5). It was observed TSS value decreased with increase in citric acid level. Decreases in TSS were also reported by Chauhan *et al.* for papaya candy [11]. Drying time also showed profound effect on TSS of watermelon rind based candy. As candies dried at DT_{14} recorded highest TSS vale of 71.80°Brix and those dried at DT_{18} recorded lowest mean TSS value 66.91°Brix. Storage period also decreased TSS value from 72.14-66.12°Brix after 60 days of storage. This decrease in TSS could be because solids are probably broken down during storage time. Alam *et al.* also reported the similar trend in aonla flakes [12].

Table 2. *Effect of stabilizers, drying and storage on titrable acidity.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	0.42 ± 0.04	0.31 ± 0.05	0.17 ± 0.09	0.09 ± 0.07	0.30 ± 0.03	0.26 ± 0.18	
	16	0.42 ± 0.09	0.38 ± 0.06	0.22 ± 0.09	0.11 ± 0.09	0.11 ± 0.04	0.25 ± 0.14	
	18	0.66 ± 0.05	0.51 ± 0.04	0.35 ± 0.09	0.23 ± 0.07	0.21 ± 0.06	0.39 ± 0.18	DT_{14}=0.39
Mean		0.50 ± 0.13	0.40 ± 0.09	0.25 ± 0.11	0.14 ± 0.09	0.21 ± 0.19	0.30 ± 0.18	
T1	14	0.63 ± 0.07	0.47 ± 0.06	0.29 ± 0.05	0.20 ± 0.08	0.11 ± 0.06	0.34 ± 0.20	
	16	0.72 ± 0.09	0.60 ± 0.06	0.34 ± 0.09	0.26 ± 0.07	0.15 ± 0.10	0.41 ± 0.23	DT_{16}=0.48
	18	0.79 ± 0.09	0.59 ± 0.06	0.43 ± 0.07	0.36 ± 0.06	0.27 ± 0.09	0.49 ± 0.20	
Mean		0.71 ± 0.10	0.55 ± 0.08	0.35 ± 0.08	0.27 ± 0.09	0.18 ± 0.10	0.41 ± 0.21	
T2	14	0.76 ± 0.09	0.58 ± 0.09	0.36 ± 0.06	0.29 ± 0.06	0.18 ± 0.06	0.43 ± 0.22	
	16	0.87 ± 0.09	0.74 ± 0.08	0.61 ± 0.06	0.42 ± 0.04	0.23 ± 0.09	0.57 ± 0.24	DT_{18}=0.54
	18	0.91 ± 0.04	0.62 ± 0.09	0.54 ± 0.07	0.51 ± 0.04	0.37 ± 0.09	0.59 ± 0.19	
Mean		0.84 ± 0.09	0.64 ± 0.10	0.50 ± 0.12	0.41 ± 0.16	0.26 ± 0.11	0.53 ± 0.22	
T3	14	0.83 ± 0.09	0.68 ± 0.07	0.56 ± 0.08	0.35 ± 0.11	0.31 ± 0.04	0.55 ± 0.21	
	16	1.00 ± 0.04	0.83 ± 0.09	0.73 ± 0.04	0.48 ± 0.09	0.35 ± 0.09	0.68 ± 0.25	
	18	1.00 ± 0.09	0.78 ± 0.08	0.67 ± 0.06	0.55 ± 0.09	0.48 ± 0.07	0.69 ± 0.20	
Mean		0.94 ± 0.10	0.76 ± 0.09	0.65 ± 0.09	0.46 ± 0.12	0.38 ± 0.09	0.64 ± 0.22	
Factor mean for storage		0.75 ± 0.01	0.59 ± 0.01	0.44 ± 0.01i	0.32 ± 0.01	0.26 ± 0.01		

T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%)
CD ($p<0.05$): Treatment=0.06; Treatment x storage=0.08; Drying time x Treatment=0.08; Storage=0.06; Drying time x storage=0.08; Drying time=0.06; Treatment x Drying time x storage=NS.

Table 3. *Effect of stabilizers, drying and storage on pH.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	5.77 ± 0.06	6.01 ± 0.06	6.19 ± 0.08	6.29 ± 0.06	6.44 ± 0.08	6.14 ± 0.24	
	16	5.59 ± 0.06	5.82 ± 0.06	5.99 ± 0.06	6.27 ± 0.06	6.38 ± 0.06	6.01 ± 0.30	
	18	4.79 ± 0.06	4.97 ± 0.06	5.21 ± 0.06	5.54 ± 0.05	5.73 ± 0.05	5.25 ± 0.36	DT_{14}=5.51
Mean		5.38 ± 0.45	5.60 ± 0.47	5.79 ± 0.45	6.03 ± 0.37	6.18 ± 0.34	5.74 ± 0.36	
T1	14	5.61 ± 0.07	5.81 ± 0.04	5.98 ± 0.06	6.19 ± 0.06	6.35 ± 0.07	5.99 ± 0.27	
	16	5.42 ± 0.05	5.59 ± 0.05	5.81 ± 0.06	6.12 ± 0.06	6.31 ± 0.05	5.79 ± 0.34	DT_{16}=5.35
	18	4.57 ± 0.06	4.78 ± 0.06	4.99 ± 0.06	5.41 ± 0.06	5.48 ± 0.06	4.99 ± 0.37	
Mean		5.20 ± 0.48	5.39 ± 0.47	5.59 ± 0.46	5.91 ± 0.37	6.04 ± 0.42	5.57 ± 0.55	
T2	14	5.43 ± 0.06	5.73 ± 0.11	5.88 ± 0.08	6.15 ± 0.10	6.26 ± 0.07	5.89 ± 0.31	
	16	5.27 ± 0.06	5.51 ± 0.06	5.70 ± 0.05	5.89 ± 0.05	6.21 ± 0.06	5.71 ± 0.33	DT_{18}=4.45
	18	4.31 ± 0.07	4.51 ± 0.06	4.70 ± 0.06	4.93 ± 0.06	5.31 ± 0.07	4.75 ± 0.36	
Mean		5.00 ± 0.52	5.25 ± 0.56	5.43 ± 0.55	5.66 ± 0.56	5.93 ± 0.46	5.38 ± 0.58	
T3	14	5.25 ± 0.06	5.44 ± 0.07	5.77 ± 0.10	5.97 ± 0.05	6.36 ± 0.06	5.76 ± 0.41	
	16	5.11 ± 0.06	5.39 ± 0.07	5.61 ± 0.06	5.84 ± 0.05	6.11 ± 0.06	5.61 ± 0.36	
	18	4.16 ± 0.09	4.37 ± 0.07	4.63 ± 0.06	4.77 ± 0.06	5.06 ± 0.09	4.60 ± 0.32	
Mean		4.84 ± 0.51	5.06 ± 0.52	5.33 ± 0.53	5.52 ± 0.57	5.84 ± 0.59	5.25 ± 0.62	
Factor mean for storage		5.10 ± 0.01	5.33 ± 0.01	5.54 ± 0.01	5.78 ± 0.01	6.00 ± 0.01		
T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%). CD (p<0.05): Treatment=0.04; Treatment x storage=0.06; Drying time x Treatment=0.06; Storage=0.04; Drying time x storage=0.06.								

Table 4. *Effect of stabilizers, drying and storage on ascorbic acid (mg/100 g) content.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	5.11 ± 0.04	4.43 ± 0.09	4.33 ± 0.07	3.17 ± 0.09	0.08 ± 0.06	3.83 ± 1.11	
	16	4.11 ± 0.08	3.04 ± 0.03	2.10 ± 0.09	2.00 ± 0.04	1.69 ± 0.09	2.59 ± 0.91	
	18	3.10 ± 0.06	2.76 ± 0.0	2.32 ± 0.05	1.21 ± 0.05	0.95 ± 0.07	2.07 ± 0.87	DT_{14}=4.16
Mean		4.11 ± 0.87	3.41 ± 0.77	2.92 ± 1.06	2.13 ± 0.85	1.57 ± 0.50	2.83 ± 1.20	
T1	14	5.17 ± 0.09	4.67 ± 0.06	4.60 ± 0.09	3.24 ± 0.09	2.57 ± 0.06	4.05 ± 1.01	
	16	4.27 ± 0.05	3.12 ± 0.04	2.28 ± 0.05	2.16 ± 0.09	2.09 ± 0.06	2.78 ± 0.86	DT_{16}=2.98
	18	3.21 ± 0.04	2.98 ± 0.06	2.50 ± 0.05	1.41 ± 0.08	1.17 ± 0.09	2.25 ± 0.85	
Mean		4.22 ± 0.85	3.59 ± 0.81	3.13 ± 1.11	2.27 ± 0.80	1.94 ± 0.61	3.03 ± 1.17	
T2	14	5.34 ± 0.09	4.86 ± 0.06	4.62 ± 0.08	3.61 ± 0.05	2.81 ± 0.04	4.25 ± 0.94	
	16	4.37 ± 0.06	3.16 ± 0.09	2.39 ± 0.09	2.32 ± 0.04	2.18 ± 0.09	2.88 ± 0.85	DT_{18}=2.43
	18	3.32 ± 0.04	3.16 ± 0.07	2.62 ± 0.08	2.44 ± 0.09	1.25 ± 0.07	2.56 ± 0.75	
Mean		4.35 ± 0.87	3.73 ± 0.85	3.21 ± 1.06	2.79 ± 0.61	2.08 ± 0.68	3.23 ± 1.11	
T3	14	5.63 ± 0.09	5.56 ± 0.06	4.78 ± 0.06	3.75 ± 0.14	2.87 ± 0.09	4.52 ± 1.10	
	16	4.56 ± 0.07	4.38 ± 0.07	3.77 ± 0.06	2.91 ± 0.04	2.66 ± 0.09	3.65 ± 0.78	
	18	3.60 ± 0.08	3.38 ± 0.05	2.93 ± 0.04	2.80 ± 0.04	1.49 ± 0.09	2.84 ± 0.76	
Mean		4.59 ± 0.88	4.44 ± 0.94	3.82 ± 0.80	3.15 ± 0.45	2.43 ± 0.64	3.67 ± 1.11	
Factor mean for storage		4.31 ± 0.01	3.79 ± 0.01	3.27 ± 0.01	2.58 ± 0.01	2.00 ± 0.01		
T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%) CD (p<0.05): Treatment=0.04; Treatment ×storage=0.06; Drying time × treatment=0.06; Storage=0.04; Treatment × drying time × storage=0.09; Drying time=0.04; Drying time ×storage=0.								

Effect of treatments, drying time and storage on reducing sugar content

Results for change in mean value of reducing sugar content during storage are presented in Table 6**.** It was observed reducing sugar content increased from 29.64-34.96% with increase in citric acid content level. The increase in reducing sugars may be attributed due to hydrolysis of sucrose by citric acid. The data also indicates that reducing sugars increased significantly throughout the drying time. Maximum mean value of reducing sugars was observed in DT_{18} (33.37%) and minimum mean value of reducing sugars content was recorded in DT_{14} (30.97%). This increase in reducing sugars might be due to concentration of fruit flavours and calories during drying. Storage period also shows significant increase in reducing sugars content. This increase in reducing sugars during storage might be due to hydrolysis of polysaccharides and inversion of non-reducing sugars to reducing sugars. Naikwadi *et al.* and Jakia *et al.* also reported increase in reducing sugar content for dehydrated fig and for pineapple preserve and candy [13,14].

Effect of treatments, drying time and storage on water activity (a_w)

Results presented in Table 7 shows effect of treatments, drying time and storage on water activity (a_w) value of watermelon rind candy. The stability and safety of foods is improved when a_w of the product is decreased. The a_w of foods influences the multiplication, metabolic activity, resistance and survival of the microorganisms present [15]**.** In all treatments a_w ranged from 0.692-0.745. Treatment T_0 showed highest mean value of 0.732 and treatment T_3 showed lowest aw value of 0.697 respectively (Table 7). This decrease in water activity may be due to higher levels of pectin within treatment. However drying for (14-18 h), water activity value of candy decreased significantly ($p<0.05$) from 0.759 to 0.650 at DT_{14} and DT_{18}. However with increase

Table 5. *Effect of stabilizers, drying and storage on TSS °Brix.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	78.91 ± 0.04	78.57 ± 0.09	76.67 ± 0.09	73.15 ± 0.09	71.56 ± 0.09	75.77 ± 3.03	
	16	75.80 ± 0.06	75.07 ± 0.06	73.74 ± 0.09	71.07 ± 0.07	70.67 ± 0.09	73.27 ± 2.14	
	18	73.71 ± 0.04	72.84 ± 0.09	72.16 ± 0.09	69.41 ± 0.09	67.71 ± 0.06	71.17 ± 2.33	DT_{14}=71.80
Mean		76.14 ± 2.26	75.49 ± 2.49	74.19 ± 1.98	71.21 ± 1.62	69.98 ± 1.74	73.40 ± 3.12	
T1	14	75.86 ± 0.09	74.42 ± 0.04	72.77 ± 0.17	71.50 ± 0.04	69.64 ± 0.09	72.84 ± 2.25	
	16	73.77 ± 0.09	72.25 ± 0.09	70.63 ± 0.23	69.91 ± 0.04	66.64 ± 0.09	70.64 ± 2.49	DT_{16}=69.39
	18	71.83 ± 0.09	69.81 ± 0.04	68.87 ± 0.30	66.10 ± 0.07	65.29 ± 0.07	68.38 ± 2.49	
Mean		73.82 ± 1.74	72.16 ± 1.99	70.76 ± 1.69	69.17 ± 2.40	67.19 ± 1.92	70.62 ± 2.99	
T2	14	73.13 ± 0.09	72.13 ± 0.09	71.80 ± 0.07	69.69 ± 0.07	67.15 ± 0.35	70.78 ± 2.20	
	16	70.17 ± 0.10	69.29 ± 0.07	68.71 ± 0.05	66.20 ± 0.14	64.43 ± 0.42	67.76 ± 2.19	DT_{18}=66.91
	18	68.38 ± 0.07	67.00 ± 0.07	65.42 ± 0.09	63.63 ± 0.09	61.10 ± 0.55	65.11 ± 2.64	
Mean		70.56 ± 2.07	69.47 ± 2.22	68.64 ± 2.76	66.51 ± 2.63	64.23 ± 2.93	67.88 ± 3.28	
T3	14	69.57 ± 0.09	69.10 ± 0.07	68.55 ± 0.10	66.10 ± 0.06	65.77 ± 0.09	67.82 ± 1.63	
	16	68.84 ± 0.08	67.86 ± 0.09	65.42 ± 0.09	64.10 ± 0.07	63.24 ± 0.09	65.89 ± 2.22	
	18	65.75 ± 0.08	64.68 ± 0.08	62.66 ± 0.07	61.68 ± 0.08	60.26 ± 0.09	63.00 ± 2.05	
Mean		68.05 ± 1.75	67.21 ± 1.97	65.54 ± 2.55	63.96 ± 1.91	63.09 ± 2.39	65.57 ± 2.78	
Factor mean for storage		72.14 ± 0.01	71.08 ± 0.01	69.78 ± 0.01	67.71 ± 0.01	66.12 ± 0.01		
T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%) CD (p<0.05): Treatment=0.04; Treatment ×storage=0.06; Drying time × treatment=0.06; Storage=0.04; Treatment × drying time × storage=0.09; Drying time=0.04; Drying time ×storage=0.								

Table 6. *Effect of stabilizers, drying and storage on reducing sugar content.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	24.17 ± 0.10	26.99 ± 0.08	28.17 ± 0.07	30.31 ± 0.06	32.19 ± 0.06	28.36 ± 2.85	
	16	26.23 ± 0.11	28.39 ± 0.06	29.42 ± 0.06	31.49 ± 0.05	32.67 ± 0.06	29.64 ± 2.35	
	18	28.21 ± 0.60	29.38 ± 0.05	30.52 ± 0.07	32.83 ± 0.06	33.71 ± 0.06	30.93 ± 2.13	DT_{14}=30.97
Mean		26.20 ± 1.74	28.25 ± 1.04	29.37 ± 1.02	31.54 ± 1.09	32.85 ± 0.67	29.64 ± 2.63	
T1	14	27.50 ± 0.07	28.59 ± 0.06	30.82 ± 0.06	31.73 ± 0.09	32.16 ± 0.07	30.16 ± 1.87	
	16	28.35 ± 0.08	29.50 ± 0.07	30.98 ± 0.06	32.83 ± 0.06	33.64 ± 0.07	31.06 ± 2.04	DT_{16}=32.20
	18	29.40 ± 0.07	30.73 ± 0.07	31.66 ± 0.11	33.89 ± 0.06	34.08 ± 0.06	31.95 ± 1.87	
Mean		28.42 ± 0.82	29.61 ± 0.93	31.15 ± 0.39	32.82 ± 0.93	33.29 ± 0.87	31.06 ± 2.02	
T2	14	29.29 ± 0.06	29.96 ± 0.03	31.21 ± 0.06	33.09 ± 0.06	33.93 ± 0.06	31.49 ± 1.83	
	16	30.37 ± 0.06	31.81 ± 0.06	32.23 ± 0.06	34.49 ± 0.08	36.29 ± 0.06	33.04 ± 2.17	DT_{18}=33.37
	18	31.31 ± 0.06	33.56 ± 0.10	34.60 ± 0.06	35.83 ± 0.06	37.91 ± 0.06	34.64 ± 2.28	
Mean		30.32 ± 0.87	31.77 ± 1.56	32.68 ± 1.50	34.47 ± 1.18	36.04 ± 1.73	33.06 ± 2.43	
T3	14	33.91 ± 0.06	31.66 ± 0.04	33.17 ± 0.08	34.58 ± 0.05	35.93 ± 0.06	33.86 ± 1.46	
	16	36.33 ± 0.11	32.83 ± 0.08	33.92 ± 0.06	35.22 ± 0.06	37.01 ± 0.06	35.07 ± 1.56	
	18	33.27 ± 0.06	34.09 ± 0.07	35.59 ± 0.07	37.73 ± 0.06	38.98 ± 0.11	35.94 ± 2.21	
Mean		34.50 ± 1.39	32.92 ± 1.07	34.23 ± 1.07	35.84 ± 1.43	37.30 ± 1.34	34.96 ± 1.94	
Factor mean for storage		29.86 ± 0.01	30.64 ± 0.01	31.86 ± 0.01	33.67 ± 0.01	34.87 ± 0.01		
T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%). CD (p<0.05): Treatment=0.04; Treatment x storage=0.06; Drying time x Treatment=0.06; Storage=0.04; Drying time x storage=0.06; Drying time=0.04; Treatment x Drying time x storage=0.09.								

in storage period water activity value increased significantly from 0.692-0.745. This increase in a_w during storage may be due to permeation of moisture content through package.

Effect of various treatments, storage periods and drying time on L, a* and b* value*

Table 8 shows L value of watermelon rind based candy. Results showed increase in lightness L* value from 41.86-53.80 with treatments. However decrease in L* value from 55.48-40.93 was observed with increase in storage period Table 8a-8c. Drying time also significantly affected the *L** value of watermelon rind candy. Results showed that candies dried for longer time 18 h had significantly lower L* value 44.69 compared to those dried for 14 h which showed L* value 51.29 at same temperature 50°C. This decrease in L* value could be due to longer drying time which darkened the colour of the candy and due to non-enzymatic browning [16]**.** Similar results were also reported by during storage of kokum rind [17]. Similarly a* value increased slightly from 1.51-2.74 with treatments (Table 8b) and decrease in a* value from 2.93-1.19 was observed with increase in storage periods. Drying time also significantly ($p<0.05$) affected the a* value. As maximum *a** value was recorded in DT_{14} (2.91) while as minimum *a** value was observed in DT_{18} (1.64). While as increase in b* value was observed with treatments, storage period and drying time from 19.39-25.31, 19.11-25.53 and DT_{14} 21.18-DT_{18} 24.09 respectively (Table 8c).

Effect of various treatments, storage periods and drying time on hardness and cohesiveness

Table 9 shows results of effect of stabilizers, storage and drying time on watermelon rind based candy. It was observed hardness increased with increase in concentration of stabilizers.

Table 7. *Effect of stabilizers, drying and storage on water activity (aw).*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	0.755 ± 0.008	0.764 ± 0.005	0.772 ± 0.004	0.784 ± 0.005	0.794 ± 0.005	0.774 ± 0.015	
	16	0.736 ± 0.009	0.745 ± 0.006	0.761 ± 0.006	0.777 ± 0.006	0.792 ± 0.007	0.762 ± 0.021	
	18	0.635 ± 0.006	0.644 ± 0.005	0.659 ± 0.006	0.677 ± 0.006	0.689 ± 0.006	0.661 ± 0.021	
Mean		0.709 ± 0.565	0.718 ± 0.056	0.731 ± 0.053	0.746 ± 0.052	0.758 ± 0.052	0.732 ± 0.054	DT_{14}=0.759
T1	14	0.742 ± 0.006	0.756 ± 0.006	0.764 ± 0.007	0.773 ± 0.005	0.794 ± 0.005	0.766 ± 0.018	
	16	0.722 ± 0.005	0.736 ± 0.006	0.747 ± 0.006	0.769 ± 0.006	0.781 ± 0.007	0.751 ± 0.022	
	18	0.627 ± 0.006	0.630 ± 0.006	0.656 ± 0.006	0.671 ± 0.005	0.679 ± 0.006	0.652 ± 0.022	
Mean		0.697 ± 0.53	0.707 ± 0.58	0.722 ± 0.50	0.738 ± 0.050	0.751 ± 0.54	0.723 ± 0.054	DT_{16}=0.741
T2	14	0.732 ± 0.009	0.746 ± 0.009	0.751 ± 0.006	0.767 ± 0.010	0.776 ± 0.008	0.754 ± 0.017	
	16	0.710 ± 0.013	0.724 ± 0.008	0.746 ± 0.009	0.759 ± 0.006	0.774 ± 0.008	0.741 ± 0.025	
	18	0.622 ± 0.006	0.630 ± 0.008	0.644 ± 0.011	0.667 ± 0.011	0.676 ± 0.008	0.648 ± 0.023	
Mean		0.688 ± 0.051	0.700 ± 0.051	0.712 ± 0.051	0.731 ± 0.048	0.742 ± 0.052	0.714 ± 0.052	DT_{18}=0.650
T3	14	0.721 ± 0.008	0.731 ± 0.009	0.739 ± 0.004	0.755 ± 0.008	0.766 ± 0.009	0.742 ± 0.018	
	16	0.679 ± 0.008	0.689 ± 0.006	0.701 ± 0.006	0.727 ± 0.006	0.755 ± 0.008	0.710 ± 0.029	
	18	0.619 ± 0.006	0.624 ± 0.006	0.635 ± 0.006	0.652 ± 0.007	0.665 ± 0.001	0.639 ± 0.019	
Mean		0.673 ± 0.044	0.681 ± 0.046	0.692 ± 0.045	0.711 ± 0.046	0.729 ± 0.48	0.697 ± 0.48	
Factor mean for storage		0.692 ± 0.001	0.702 ± 0.001	0.715 ± 0.001	0.732 ± 0.001	0.745 ± 0.001		
T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%) CD (p<0.05): Treatment=1.56; Treatment x storage=NS; Drying time x Treatment=2.21; Storage=1.56; Drying time x storage=2.21; Drying time=1.56; Treatment x Drying time x storage=NS.								

Table 8a. *Effect of stabilizers, drying and storage on L* value.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	53.51 ± 0.04	48.36 ± 0.09	44.91 ± 0.04	42.54 ± 0.07	37.60 ± 0.05	45.48 ± 5.61	
	16	48.84 ± 0.08	45.17 ± 0.09	42.55 ± 0.06	38.73 ± 0.07	33.94 ± 0.07	41.84 ± 5.33	
	18	44.17 ± 0.09	42.81 ± 0.09	38.44 ± 0.08	34.27 ± 0.04	31.61 ± 0.04	38.26 ± 4.98	
Mean		48.84 ± 4.04	45.60 ± 2.62	41.96 ± 2.83	38.51 ± 2.61	34.38 ± 2.61	41.86 ± 5.98	DT_{14}=51.29
T1	14	57.78 ± 0.05	53.51 ± 0.04	49.78 ± 0.07	45.01 ± 0.07	41.50 ± 0.05	49.51 ± 6.01	
	16	53.48 ± 0.07	49.81 ± 0.04	46.77 ± 0.04	43.55 ± 0.07	39.51 ± 0.05	46.63 ± 5.01	
	18	49.79 ± 0.07	46.28 ± 0.07	43.50 ± 0.07	41.30 ± 0.17	38.55 ± 0.07	43.88 ± 4.03	
Mean		53.68 ± 3.46	49.87 ± 3.13	46.68 ± 2.71	43.29 ± 0.62	39.85 ± 1.30	46.67 ± 5.48	DT_{16}=47.90
T2	14	60.66 ± 0.05	56.27 ± 0.07	52.71 ± 0.07	48.08 ± 0.06	44.89 ± 0.06	52.51 ± 5.80	
	16	56.01 ± 0.06	52.46 ± 0.05	49.28 ± 0.08	45.04 ± 0.04	43.27 ± 0.07	49.21 ± 4.84	
	18	53.46 ± 0.09	49.00 ± 0.07	46.56 ± 0.09	43.52 ± 0.04	41.44 ± 0.09	46.80 ± 4.36	
Mean		56.69 ± 3.13	52.58 ± 3.14	49.52 ± 2.67	45.55 ± 2.01	43.20 ± 1.49	49.51 ± 5.46	DT_{18}=44.69
T3	14	66.79 ± 0.06	61.47 ± 0.06	58.00 ± 0.05	52.73 ± 0.05	49.27 ± 0.09	57.65 ± 6.42	
	16	62.56 ± 0.06	57.77 ± 0.07	52.69 ± 0.09	49.82 ± 0.04	46.79 ± 0.09	53.93 ± 5.83	
	18	58.77 ± 0.08	52.71 ± 0.04	49.82 ± 0.12	45.01 ± 0.09	42.77 ± 0.09	49.81 ± 5.87	
Mean		62.70 ± 3.47	57.31 ± 3.80	53.50 ± 3.59	49.24 ±	46.28 ± 2.83	53.80 ± 6.73	
Factor mean for storage		55.48 ± 0.01	51.34 ± 0.01	47.92 ± 0.01	44.13 ± 0.01	40.93 ± 0.01		
T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%) CD (p<0.05): Treatment=0.06; Treatment x storage=0.09; Drying time x Treatment=0.09; Storage=0.06; Drying time x storage=0.09; Drying time=0.06; Treatment x Drying time x storage=0.12.								

Table 8b. *Effect of stabilizers, drying and storage on a* value.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	3.41 ± 0.04	3.28 ± 0.09	2.85 ± 0.06	1.77 ± 0.06	0.89 ± 0.06	2.44 ± 1.00	
	16	1.94 ± 0.09	2.82 ± 0.05	1.91 ± 0.04	1.20 ± 0.05	0.77 ± 0.06	1.73 ± 0.72	
	18	0.81 ± 0.06	0.52 ± 0.06	0.23 ± 0.07	0.18 ± 0.06	0.06 ± 0.05	0.36 ± 0.28	
Mean		2.05 ± 1.35	2.20 ± 1.26	1.66 ± 1.14	1.05 ± 0.69	0.57 ± 0.39	1.51 ± 1.13	DT_{14}=2.91
T1	14	3.55 ± 0.05	3.48 ± 0.05	3.06 ± 0.05	2.65 ± 0.06	1.73 ± 0.03	2.89 ± 0.69	
	16	2.78 ± 0.07	2.55 ± 0.06	1.71 ± 0.06	1.05 ± 0.08	0.70 ± 0.06	1.76 ± 0.83	
	18	1.89 ± 0.17	1.57 ± 0.04	1.43 ± 0.05	1.13 ± 0.05	0.91 ± 0.06	1.38 ± 0.35	
Mean		2.74 ± 0.72	2.53 ± 0.82	2.06 ± 0.75	1.61 ± 0.78	1.11 ± 0.47	2.01 ± 091	DT_{16}=2.01
T2	14	3.84 ± 0.18	3.57 ± 0.05	3.17 ± 0.09	2.87 ± 0.06	1.87 ± 0.05	3.06 ± 0.70	
	16	3.07 ± 0.06	2.68 ± 0.06	2.47 ± 0.05	1.61 ± 0.03	0.93 ± 0.04	2.15 ± 0.80	
	18	2.79 ± 0.06	2.60 ± 0.06	2.38 ± 0.05	1.85 ± 0.07	1.50 ± 0.07	2.22 ± 0.49	
Mean		3.23 ± 0.48	2.95 ± 0.46	2.67 ± 0.37	2.11 ± 0.58	1.43 ± 0.41	2.48 ± 0.78	DT_{18}=1.64
T3	14	3.97 ± 0.06	3.97 ± 0.06	3.48 ± 0.07	2.96 ± 0.06	2.13 ± 0.09	3.23 ± 0.66	
	16	3.77 ± 0.06	3.77 ± 0.06	2.64 ± 0.06	1.78 ± 0.07	1.00 ± 0.07	2.41 ± 0.98	
	18	3.32 ± 0.05	3.32 ± 0.05	2.69 ± 0.06	2.21 ± 0.04	1.75 ± 0.07	2.58 ± 0.57	
Mean		3.68 ± 0.29	3.14 ± 0.37	2.93 ± 0.41	2.31 ± 0.52	1.63 ± 0.50	2.74 ± 0.82	
Factor mean for storage		2.93 ± 0.01	2.71 ± 0.01	2.33 ± 0.01	1.77 ± 0.01	1.19 ± 0.01		
T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%). CD (p<0.05): Treatment=0.04; Treatment x storage=Drying time x Treatment=0.06; Storage=0.04; Drying time x storage=0.06; Drying time=0.04; Treatment x Drying time x storage=0.09.								

Maximum hardness value of 96.15 N was obtained for treatment T3 (Table 9a), and lowest value 79.35 N was observed for treatment control. This increase in hardness may be due to increase in pectin level. Drying time also showed increase in hardness value, as maximum hardness value was found in DT_{14} (82.46). Increase in hardness during drying may be due to solidification of sugar syrup cause by high drying time. However with increase in storage period, the hardness value decreased

Table 8c. *Effect of storage periods, treatments and drying time on b* value.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	12.20 ± 0.04	15.08 ± 0.05	18.89 ± 0.04	20.28 ± 0.06	21.71 ± 0.06	17.63 ± 3.62	
	16	14.88 ± 0.06	17.20 ± 0.08	19.93 ± 0.06	21.91 ± 0.07	22.23 ± 0.06	19.23 ± 2.91	
	18	17.37 ± 0.06	19.84 ± 0.08	21.72 ± 0.06	23.19 ± 0.06	24.43 ± 0.06	21.31 ± 2.58	DT_{14}=21.18
Mean		14.82 ± 2.23	17.37 ± 2.06	20.18 ± 1.23	21.80 ± 1.26	22.79 ± 1.25	19.39 ± 3.36	
T1	14	16.57 ± 0.06	18.40 ± 0.06	20.48 ± 0.06	21.85 ± 0.06	23.55 ± 0.08	20.17 ± 2.55	
	16	17.87 ± 0.06	19.64 ± 0.07	21.51 ± 0.05	23.84 ± 0.06	25.30 ± 0.06	21.63 ± 2.79	
	18	20.19 ± 0.05	21.92 ± 0.07	23.30 ± 0.06	25.27 ± 0.08	26.34 ± 0.07	23.40 ± 2.29	DT_{16}=22.45
Mean		18.21 ± 1.58	19.99 ± 1.54	21.76 ± 1.23	23.65 ± 1.49	25.06 ± 1.22	21.73 ± 2.83	
T2	14	19.66 ± 0.07	21.73 ± 1.03	22.92 ± 0.06	24.19 ± 0.06	25.77 ± 0.06	22.85 ± 2.15	
	16	20.19 ± 0.06	22.54 ± 0.37	23.84 ± 0.07	25.12 ± 0.06	26.20 ± 0.07	23.58 ± 2.16	
	18	22.39 ± 0.06	23.93 ± 0.33	25.68 ± 0.04	26.61 ± 0.06	27.27 ± 0.06	25.18 ± 1.85	DT_{18}=24.09
Mean		20.75 ± 1.25	22.73 ± 0.96	24.15 ± 1.21	25.31 ± 1.05	26.41 ± 0.66	23.87 ± 2.21	
T3	14	21.52 ± 0.06	22.49 ± 0.06	24.14 ± 0.08	25.71 ± 0.08	26.56 ± 0.11	24.08 ± 1.96	
	16	22.63 ± 0.08	23.61 ± 0.08	25.68 ± 0.09	26.84 ± 0.06	27.98 ± 0.10	25.35 ± 2.05	
	18	23.82 ± 0.06	24.51 ± 0.07	26.63 ± 0.08	28.42 ± 0.10	29.06 ± 0.08	26.49 ± 2.14	
Mean		22.65 ± 0.99	23.53 ± 0.87	25.48 ± 1.09	26.99 ± 1.17	27.87 ± 1.08	25.31 ± 2.23	
Factor mean for storage		19.11 ± 0.01	20.91 ± 0.01	22.89 ± 0.01	24.44 ± 0.01	25.53 ± 0.01		
T0=without any treatment; T1=citric acid (1%) and pectin (1%); T2=citric acid (1%) and pectin (1.5%); T3=citric acid (1.5%) and pectin (1.5%) CD (p<0.05): Treatment=0.04; Treatment x storage=0.06; Drying time x Treatment=0.06; Storage=0.04; Drying time x storage=0.06; Drying time=0.04; Treatment x Drying time x storage=0.09.								

Table 9a. *Effect of storage periods, treatments and drying on hardness.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	82.65 ± 0.04	79.79 ± 0.09	74.68 ± 0.09	68.44 ± 0.09	62.33 ± 0.09	73.57 ± 3.03	
	16	86.83 ± 0.06	84.99 ± 0.06	81.04 ± 0.09	78.71 ± 0.07	72.82 ± 0.09	79.74 ± 2.14	
	18	91.73 ± 0.04	88.00 ± 0.09	84.77 ± 0.09	81.54 ± 0.09	77.88 ± 0.06	84.78 ± 2.33	DT_{14}=82.46
Mean		87.07 ± 2.26	84.23 ± 2.49	80.16 ± 1.98	76.23 ± 1.62	71.01 ± 1.74	79.35 ± 3.12	
T1	14	88.01 ± 0.09	85.22 ± 0.04	82.12 ± 0.17	77.66 ± 0.04	69.31 ± 0.09	80.46 ± 2.25	
	16	90.01 ± 0.09	88.00 ± 0.09	85.17 ± 0.23	80.21 ± 0.04	75.94 ± 0.09	83.86 ± 2.49	
	18	96.54 ± 0.09	93.00 ± 0.04	90.11 ± 0.30	86.16 ± 0.07	81.20 ± 0.07	89.40 ± 2.49	DT_{16}=87.36
Mean		91.52 ± 1.74	88.74 ± 1.99	85.80 ± 1.69	81.34 ± 2.40	75.48 ± 1.92	84.57 ± 2.99	
T2	14	93.78 ± 0.09	90.85 ± 0.09	86.54 ± 0.07	80.36 ± 0.07	75.16 ± 0.35	85.33 ± 2.20	
	16	97.91 ± 0.10	92.14 ± 0.07	89.09 ± 0.05	84.68 ± 0.14	77.40 ± 0.42	88.24 ± 2.19	
	18	101.14 ± 0.07	98.51 ± 0.07	93.48 ± 0.09	88.86 ± 0.09	82.54 ± 0.55	92.90 ± 2.64	DT_{18}=91.85
Mean		97.61 ± 2.07	93.83 ± 2.22	89.70 ± 2.76	84.63 ± 2.63	78.36 ± 2.80	88.82 ± 3.28	
T3	14	98.98 ± 0.09	95.48 ± 0.07	91.40 ± 0.10	86.26 ± 0.06	80.39 ± 0.09	90.50 ± 1.63	
	16	105.29 ± 0.08	101.94 ± 0.09	97.64 ± 0.09	93.65 ± 0.07	89.65 ± 0.09	97.63 ± 2.22	
	18	110.19 ± 0.08	105.36 ± 0.08	99.40 ± 0.07	95.86 ± 0.08	90.81 ± 0.09	100.32 ± 2.05	
Mean		104.82 ± 1.75	100.92 ± 1.97	96.14.14 ± 2.55	91.92 ± 1.91	86.95 ± 2.39	96.15 ± 2.78	
Factor mean for storage		95.25 ± 0.01	91.93.15 ± 0.01	87.95 ± 0.01	83.53 ± 0.01	77.95 ± 0.01		

Table 9b. *Effect of storage periods, treatments and drying on cohesiveness.*

Treatment	Drying time/ storage	0 Day	15th Day	30th Day	45th Day	60th Day	Mean	Factor means for drying time (DT)
T0	14	2.65 ± 0.05	2.07 ± 0.04	1.34 ± 0.06	1.19 ± 0.05	1.01 ± 0.05	1.65 ± 0.26	
	16	2.89 ± 0.09	2.39 ± 0.03	2.12 ± 0.05	1.58 ± 0.05	1.24 ± 0.09	2.04 ± 0.26	
	18	3.33 ± 0.04	2.52 ± 0.04	2.39 ± 0.04	2.27 ± 0.04	1.58 ± 0.09	2.41 ± 0.25	DT_{14}=82.46
Mean		2.95 ± 0.04	2.32 ± 0.06	1.95 ± 0.19	1.68 ± 0.18	1.27 ± 0.13	2.03 ± 0.29	
T1	14	3.42 ± 0.03	2.79 ± 0.06	2.52 ± 0.04	2.34 ± 0.06	1.23 ± 0.09	2.46 ± 0.27	
	16	3.71 ± 0.04	2.88 ± 0.07	2.78 ± 0.04	2.62 ± 0.08	1.44 ± 0.06	2.68 ± 0.24	
	18	3.98 ± 0.09	3.82 ± 0.03	2.85 ± 0.04	2.54 ± 0.04	1.69 ± 0.04	2.97 ± 0.22	DT_{16}=87.36
Mean		3.70 ± 0.10	3.16 ± 0.15	2.71 ± 0.21	2.50 ± 0.20	1.45 ± 0.17	2.70 ± 0.29	
T2	14	3.52 ± 0.06	3.09 ± 0.06	2.98 ± 0.07	2.40 ± 0.05	1.44 ± 0.04	2.68 ± 0.27	
	16	3.85 ± 0.05	3.17 ± 0.07	2.99 ± 0.05	2.81 ± 0.04	1.61 ± 0.06	2.88 ± 0.25	
	18	4.14 ± 0.04	3.92 ± 0.05	3.17 ± 0.04	2.95 ± 0.03	1.74 ± 0.05	3.18 ± 0.18	DT_{18}=91.85
Mean		3.83 ± 0.07	3.39 ± 0.12	3.04 ± 0.15	2.72 ± 0.17	1.59 ± 0.14	2.91 ± 0.26	
T3	14	3.68 ± 0.05	3.44 ± 0.04	3.15 ± 0.04	2.69 ± 0.03	1.52 ± 0.06	2.89 ± 0.21	
	16	3.99 ± 0.02	3.62 ± 0.06	3.32 ± 0.06	2.72 ± 0.05	2.12 ± 0.04	3.15 ± 0.21	
	18	4.28 ± 0.04	3.77 ± 0.04	3.52 ± 0.06	2.96 ± 0.04	2.55 ± 0.09	3.41 ± 0.24	
Mean		3.98 ± 0.16	3.61 ± 0.19	3.33 ± 0.26	2.79 ± 0.12	2.06 ± 0.14	3.15 ± 0.25	
Factor mean for storage		3.61 ± 0.09	3.12 ± 0.09	2.75 ± 0.09	2.42 ± 0.09	1.59 ± 0.09		

which ranged from 95.25 N-77.95 N respectively. This decrease in hardness might be due to increase in moisture content during storage. Similarly the cohesiveness value of candy increased with increase in percentage of stabilizer and drying time was 2.03 N-3.15 N and 2.42 N-3.99 N respectively. But decrease in hardness value from 3.61 N-1.59 N was obtained with increase on storage days (Table 9b).

CONCLUSION

The present study focused on utilization of fruit by-products for the development of value added product. As the watermelon rind is a good source of phenolic compounds, flavonoid compounds, dietary fiber, antioxidants, macro and micro elements. The present findings also recommended use of watermelon rind in food processing to produce candy or other food products contained bioactive functional components which having a numerous beneficial effects.

CONFLICT OF INTEREST

None

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