

## Processing and Quality Evaluation of Osmotic Dehydrated Coconut

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### ABSTRACT

Osmotic dehydrated coconut is the edible, dried-out shredded coconut meat prepared from fresh kernel of fully matured coconut. Acidified salt solution and sugar solution were used as osmotic agents for the preparation of dehydrated coconut. The free fatty acid content and peroxide value of osmotic dehydrated coconut ranged from 0.38 to 0.41 per cent of oleic acid and 4.22 to 4.52 (mEq/kg), respectively. The osmotic dehydrated coconut with sugar solution had highest pH value (8.05) and lowest value (5.20) found in acidified salt dehydrated coconut. Reducing sugar content ranged from 4.40 to 7.88 per cent and total sugar content was between the ranges of 8.00 to 11.93 per cent. The organoleptic characteristics such as appearance, colour, texture, flavour, taste and overall acceptability were analysed for each sample. The rancid flavour was felt in the control sample and a drastic change in the taste was found in the control sample, which had reduced its score value from 4.0 to 2.0. The changes noted in each quality attribute had influenced the overall acceptability score of the stored sample. The microbial load of bacteria, fungi and actinomycetes present in the dehydrated coconut were between the ranges of 3.0 to 7.0 CFU/g x 10<sup>6</sup>, 1.0 to 4.0 CFU/g x 10<sup>2</sup> and 1.0 to 6.0 CFU/g x 10<sup>3</sup>, respectively. The control sample contains highest microbial population than the osmotic dehydrated samples.

**Keywords:** Coconut, Osmotic agent, Peroxide value, Organoleptic, Storage

### INTRODUCTION

India is the largest producer of coconut with a production of 17,000 million nuts. Coconut contribution to nation's GDP is about 15,000 crores rupees and 72% of world's total production is from India and productivity is also high in India. About 90 per cent of the production comes from the Southern states. Out of which the contribution of Kerala is 31

per cent followed by Karnataka with 28 per cent and Tamil Nadu with 27 per cent of the total coconut available in India (Kalidas Kalimuthu & Raghavi, 2019). About 55 per cent go for the domestic consumption in the raw form. Another 40 per cent is used for copra, desiccated coconut and seeds and the remaining 5.0 per cent is consumed as tender nuts for water.

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The processed products made out of coconut include desiccated coconut, edible copra, coconut cream, coconut powder, coconut milk, coconut syrup and coconut honey. These products occupied an important place in the confectionary, bakery and other food industries. Desiccated coconut is the edible, dried-out shredded coconut meat prepared from fresh kernel of fully matured coconut. Desiccated coconut is the most important processed product of coconut and its annual production is estimated as 10,000 metric tonnes (Sandhu et al., 1992). It is used both in household foods and processed foods particularly in ready-to-cook mixes and in packaged and canned foods. In the bakery and confectionery industry desiccated coconut is a favoured ingredient (Krishnakumar et al., 1991). About 40 per cent of the total production is consumed by the biscuit and confectionery manufacturers in organised sector. Unorganised sector consumes about 55 per cent, out of which about 20 per cent is marketed in Delhi. Unorganised sector includes local bakeries, sweet makers and pan masala makers. Household consumption is about five per cent and limited to upper income group in big cities (Sugata Ghose, 1998). Till date, the preservation of coconut kernel has been done only by removing the moisture content to a safer level for the preparation of copra and desiccated coconut. The fat content of the desiccated coconut is easily oxidised either by lipase or by the enzymes of microbes during storage. The chain of actions such as oxidation of fatty acids, release of free fatty acids contributed to the development of rancidity and off-flavour in the coconut based products. But osmotic dehydration process prevents the oxidation and enhance the shelf life of the product. Hence, the study was undertaken to standardize the processing of osmotic dehydration of coconut.

## MATERIALS AND METHODS

### Procurement of coconut

Coconuts used in this study were purchased from the local market of Madurai district, Tamil Nadu. Matured coconuts containing only small quantity of water were selected for the study. The maturity was judged by the metallic sound when tapped with the finger nail.

### Processing of osmotic dehydrated coconut

The process involved in the preparation of osmotic dehydrated coconut are preparation of

sample, Preparation of osmotic agents, Osmosis of coconut scrapings and dehydration (Fig.1).

### Preparation of sample

The selected coconuts were broken into two halves and scraped by using a stainless steel scraper (without testa). The scraped uniform size coconut was selected and steam blanched for 10 min.

### Preparation of osmotic agents

#### A. Acidified salt solution (without antioxidant)

Acidified salt solution containing 1,2,3,4, and 5 per cent salt with varying concentrations of acetic acid viz., 0.5, 1.0, 1.25 and 1.5 per cent were prepared. For the preparation of acidified salt solution, desired volume of acetic acid was added to the sterilized vessel and boiled distilled water was added to make up the correct concentration. The solution was filtered through a clean muslin cloth and cooled.

#### B. Acidified salt solution (with antioxidant)

The soak solution (acidified salt solution) was prepared as mentioned above. A portion of soak solution (200 ml) was taken. Butylated hydroxy toluene (0.1% BHT) and glycerol mono stearate (0.5% GMS) were added and heated to 95°C for 10 min to melt, cooled and whipped for 3.0 min. The whipped antioxidant emulsion was added to the remaining portion of the soak solution. The contents were mixed well and filtered through a clean muslin cloth.

#### C. Sugar solution

Sugar solution containing 10, 20, 30, 40 and 50° brix were prepared. For the preparation of sugar solution, desired quantity of sugar was taken in a sterilized vessel and distilled water was added and boiled to make up correct concentration. The solution was filtered through a clean muslin cloth and cooled.

### Osmosis of coconut scrapings in the soak solution

The coconut scrapings and soak solution were taken in the ratio of 1:2. The blanched coconut scrapings were soaked individually in glass bottles in soak solutions. To preserve the colour and to prevent the spoilage of coconut samples 250 ppm of SO<sub>2</sub> was added to the soak solution. The quality of the samples were studied periodically at 24, 48, 72, 96 and 120 hr.

### Dehydration

After osmosis, the solution was drained out from the coconut scrapings and dried separately in the mechanical dryer at 60°C for

4 to 5 hr (upto 4.0% moisture). Each dried sample was cooled immediately.

#### Evaluation of the dehydrated coconut

Organoleptic evaluation was conducted for all the dehydrated coconut samples by using 4 to 1 hedonic scale to fix the optimum osmotic time and concentration of osmotic agent. The samples treated with 1.0 per cent salt and 1.0 per cent acid without and with antioxidant, 10° and 20° brix sugar solution treated samples had secured the highest score value for overall acceptability when compared with other treated sample. The osmosis time was fixed as 24 hr.

#### Physico - Chemical analysis

The free fatty acid and peroxide value were determined by the method described by Sadasivam and Manickam (1996). The pH was determined with the help of pH meter

calibrated with the standard buffer solutions (AOAC, 1990). The titrable acidity was calculated by titrate the samples against 0.1 N sodium hydroxide by using phenolphthalein as indicator. Moisture content was determined by weight loss of 5 g sample after heating at 110°C for 2 hours. The ash content was measured by weight loss of 5 g of moisture free sample for heating at 550° C for 5 hours (AOAC, 1990). The crude fat content in the samples was determined by ether extraction using glass soxhlet (AOAC, 1990). The crude protein was determined by using Micro Kjeldhal method. Sugar content in the samples was determined by using Lane - Eynon method (AOAC, 1990). Calcium, Iron and phosphorus were determined by using flame photometer (Piper, 1950).

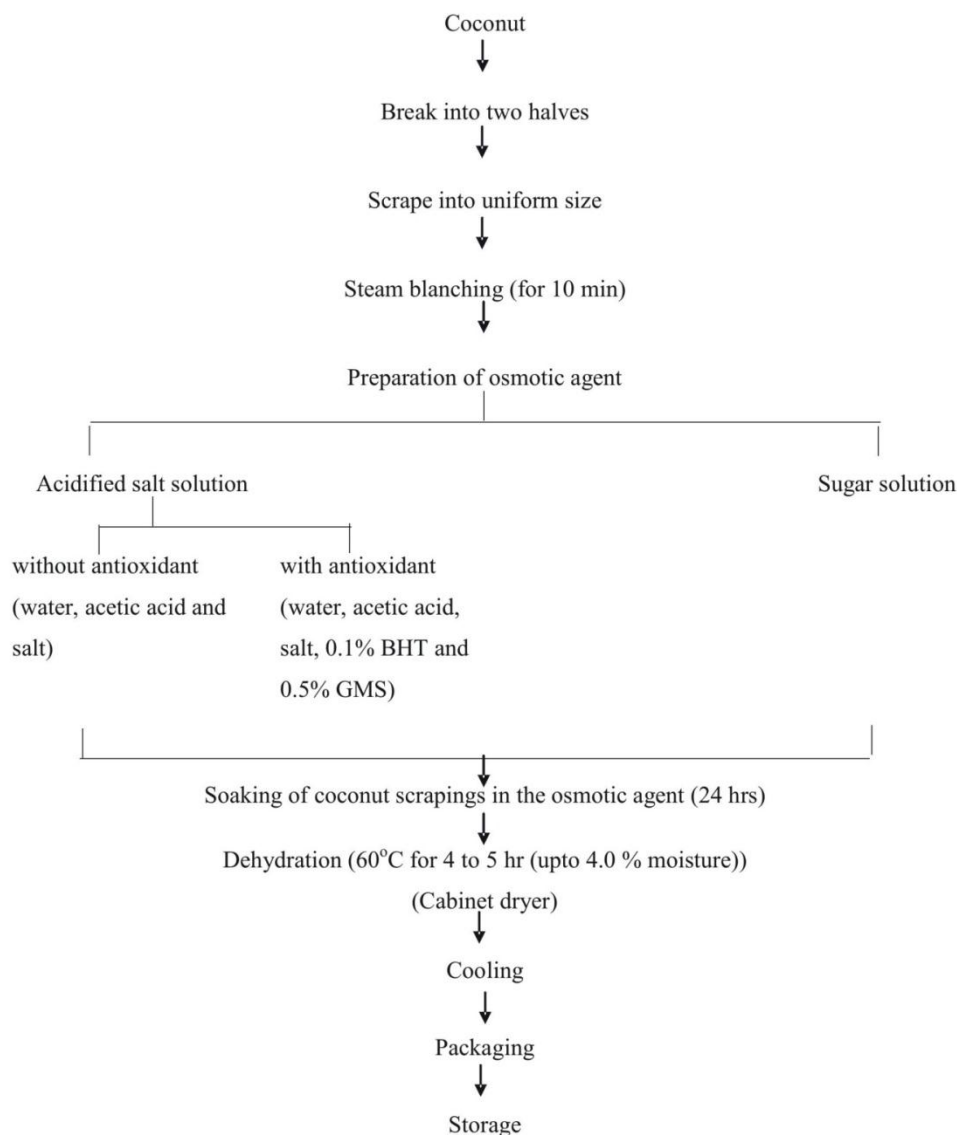


Fig. 1: Flow chart for the processing of osmotic dehydrated coconut

### Microbial load

The microbial load of osmotic dehydrated coconut samples were enumerated by the method described by Istawan Kiss (1984). The samples were serially diluted. Dilution of  $10^{-2}$ ,  $10^{-3}$  and  $10^{-6}$  were taken for all the analysis. One ml of the serial dilutions of the samples were taken in the petri dishes and appropriate media was added for the specific organism. The plates were incubated at room temperature for 48 h for bacteria, 3 days for fungi and actinomycetes and the colonies were counted.

### Storage studies

The dehydrated coconut samples were prepared in a large scale as per the selected osmotic agents. The dehydrated samples were packed individually in 300 gauge thickness polyethylene bags. To study the storage behaviour of the osmotic dehydrated coconut, the changes in the organoleptic characteristics were analysed once in 30 days during the storage period (three months).

### Statistical analysis

The results of the experiment were subjected to statistical analysis as described by Rangaswamy (2009). Critical differences were

worked out at 5% probability level and presented.

## RESULT AND DISCUSSION

### Physico-chemical characteristics of coconut

Physico-chemical characteristics of the selected coconuts were studied and presented in table 1. The fresh coconut (scrapings) contained moisture (39.18 %), protein (4.39 %), fat (42.90 %), total sugar (5.69 %), reducing sugar (2.48 %), fiber (4.22 %) and ash (1.98 %). The calcium, iron and phosphorus content of coconut were 11.50, 2.10 and 248.17 mg, respectively. The kernel without testa (wet) yielded 72 to 75 per cent of scrapings. The chemical composition of the coconut was reported by Gopalan et al. (1999) as moisture (36.3 %), protein (4.5 %) and fat (41.6 %). Vennila and Pappiah (1998) reported that the physical characteristics of coconut such as whole nut weight, kernel weight and kernel thickness (with and without testa). The values given by them were found to be more or less similar to that of the present investigation.

**Table 1: Physico-chemical characteristics of the coconut**

S. No.	Physical characteristics (per nut)		
1.	Whole nut (g)	-	363.00 ± 11.85
2.	Coconut water (ml)	-	154.90 ± 4.85
3.	Kernel weight (g)	-	215.00 ± 6.29
4.	Coconut shell weight (g)	-	148.00 ± 4.73
5.	Kernel without testa (g)	-	202.50 ± 5.92
6.	Kernel thickness with testa (mm)	-	13.00 ± 0.28
7.	Kernel thickness without testa (mm)	-	11.50 ± 0.38
<b>Chemical composition (100 g)</b>			
1.	Moisture (%)	-	39.18 ± 0.99
2.	Protein (%)	-	4.39 ± 0.14
3.	Fat (%)	-	42.90 ± 0.92
4.	Total sugar (%)	-	5.69 ± 0.08
5.	Reducing sugar (%)	-	2.48 ± 0.07
6.	Fibre (%)	-	4.22 ± 0.13
7.	Ash (%)	-	1.98 ± 0.06
8.	Calcium (mg)	-	11.50 ± 0.34
9.	Iron (mg)	-	2.10 ± 0.07
10.	Phosphorus (mg)	-	248.17 ± 7.93

### Physico-chemical characteristics of the osmotic dehydrated coconut

Physico-Chemical characteristics of osmotic dehydrated coconut samples are given in Table 2. The free fatty acid content, peroxide value, acidity, pH, sugar content and mineral content of the dehydrated coconut were analysed.

#### Free fatty acid content and Peroxide value

The free fatty acid content and peroxide value of osmotic dehydrated coconut ranged from 0.38 to 0.41 per cent of oleic acid and 4.22 to 4.52 (mEq/kg), respectively. The free fatty acid content was highest in the control sample (dehydrated without osmotic agents) and lowest in the osmotic dehydrated coconut in which acidified salt solution added with antioxidants is used as osmotic agent (T<sub>2</sub>). Among these dehydrated samples control had highest and T<sub>2</sub> had lowest peroxide value. A significant difference in the oleic acid content and peroxide value of the dehydrated coconut samples were observed between treatments. Kumar et al., (1993) found that the stored coconut treated with antioxidant had lesser

oleic acid content than the one without antioxidant. Similar situation was observed in the present study too.

#### Acidity and pH

The acidity of the dehydrated coconut sample T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub>, T<sub>2</sub> and T<sub>4</sub> were 0.24, 0.40, 0.40, 0.24 and 0.24 per cent, respectively. The osmotic dehydrated coconut with sugar solution (T<sub>4</sub>) had highest pH value (8.05) and lowest value (5.20) found in acidified salt dehydrated coconut (T<sub>2</sub>).

#### Sugar and Iron content

Reducing sugar content ranged from 4.40 to 7.88 per cent and total sugar content was between the ranges of 8.00 to 11.93 per cent. Significant difference existed between the samples for the sugar content. The osmotic dehydrated coconut with sugar solution (T<sub>4</sub>) had highest iron content (4.92 mg) and lowest value (3.51 mg) found in control sample (T<sub>0</sub>). The data analysed by statistically indicated a significant difference in the iron content between treatments.

**Table 2: Physico-chemical characteristics of the osmotic dehydrated coconut**

Chemical composition	Control (T <sub>0</sub> )	Acidified salt solution		Sugar solution		CD (P ≤ 0.05)
		Without antioxidants (T <sub>1</sub> )	With antioxidants (T <sub>2</sub> )	10° Brix (T <sub>3</sub> )	20° Brix (T <sub>4</sub> )	
Free fatty acid (% of oleic acid)	0.41	0.40	0.38	0.40	0.39	0.02
Peroxide value (mEq/kg)	4.52	4.31	4.22	4.45	4.38	0.12
Acidity (%)	0.24	0.40	0.40	0.24	0.24	0.01
pH	6.27	5.20	5.21	7.43	8.05	0.22
Total sugar (%)	8.00	8.25	8.26	10.58	11.93	0.20
Reducing sugar (%)	4.40	4.45	4.41	7.05	7.88	0.18
Iron (mg)	3.51	4.10	4.16	4.80	4.92	0.13

### Organoleptic characteristics of osmotic dehydrated coconut during storage (3 months period)

The organoleptic characteristics such as appearance, colour, texture, flavour, taste and overall acceptability were analysed for each samples before and during storage at regular intervals (once in 30 days) for three months. The organoleptic score for the dehydrated coconut has been presented in table 3.

The control had the score value as 3.8 for appearance upto one month after that it had reduced to 2.5, whereas T<sub>1</sub> and T<sub>4</sub> have maintained the maximum score (4.0) upto

three months. The freshly prepared T<sub>1</sub> sample had milky white in colour (4.0) which had changed to dull white during storage. The colour of the control was changed from dull white with yellow tint between 1 and 3 months of storage.

The crisp texture of the T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> were maintained throughout the study period, whereas the control changed into moderately crisp texture during storage. The rancid flavour was felt in the control sample from 2<sup>nd</sup> month onwards. A drastic change in the taste was found in the control sample which had reduced its score value from 4.0 to

2.0. The changes noted in each quality attribute had influenced the overall acceptability score of the stored sample. The overall acceptability of were ranked in the order of T<sub>2</sub>, T<sub>4</sub>, T<sub>1</sub>, T<sub>3</sub> and T<sub>0</sub>.

Vennila and Pappiah (1998) reported that the osmotically dehydrated coconut pieces

had maintained its original colour, flavour and texture even after storing for 3 months. In the present study T<sub>2</sub> had maintained all the quality attributes throughout the storage study whereas control showed a change in colour, texture, flavour, taste and overall acceptability at the end of the storage at room temperature.

**Table 3: Organoleptic characteristics of osmotic dehydrated coconut during storage (3 months period)**

Quality attributes	Control (T <sub>0</sub> )	Acidified salt solution		Sugar solution	
		Without antioxidants (T <sub>1</sub> )	With antioxidants (T <sub>2</sub> )	10° Brix (T <sub>3</sub> )	20° Brix (T <sub>4</sub> )
Appearance	Acceptable – Moderately acceptable (3.8 – 2.5)	Highly acceptable – Acceptable (4.0 – 3.8)	Highly acceptable (4.0 – 4.0)	Highly acceptable – Acceptable (4.0 – 3.9)	Highly acceptable (4.0 – 4.0)
Colour	Dull white – Yellow tint (3.7 – 2.4)	Milky white – Dull white (4.0 – 3.7)	Milky white (4.0 – 4.0)	Milky white (4.0 – 4.0)	Milky white (4.0 – 4.0)
Texture	Crisp – Moderately crisp (4.0 – 3.6)	Crisp (4.0 – 4.0)	Crisp (4.0 – 4.0)	Crisp (4.0 – 4.0)	Crisp (4.0 – 4.0)
Flavour	Natural coconut flavour - Rancid (4.0 – 2.2)	Natural coconut flavour - Slightly rancid flavour (4.0 – 3.8)	Natural coconut flavour - Very slight rancid flavour (4.0 – 3.9)	Natural coconut flavour - Slightly rancid flavour (4.0 – 3.9)	Natural coconut flavour - Very slight rancid flavour (4.0 – 4.0)
Taste	Highly acceptable – Moderately acceptable (4.0 – 2.0)	Highly acceptable – Acceptable (4.0 – 3.9)	Highly acceptable (4.0 – 4.0)	Highly acceptable – Acceptable (4.0 – 3.9)	Highly acceptable (4.0 – 4.0)
Overall acceptability	Highly acceptable – Moderately acceptable (4.0 – 2.0)	Highly acceptable – Acceptable (4.0 – 3.9)	Highly acceptable (4.0 – 4.0)	Highly acceptable – Moderately acceptable (4.0 – 3.9)	Highly acceptable (4.0 – 4.0)

### Microbial population of osmotic dehydrated coconut

The microbial population present in the dehydrated coconut is depicted in Table 4. The microbial load of bacteria, fungi and actinomycetes present in the dehydrated coconut were between the ranges of 3.0 to 7.0 CFU/g x 10<sup>6</sup>, 1.0 to 4.0 CFU/g x 10<sup>2</sup> and 1.0 to

6.0 CFU/g x 10<sup>3</sup>, respectively. The control sample contains highest microbial population than the osmotic dehydrated samples. Vennila (2003) reported that the microbial population of the control and treated dehydrated coconut. The bacterial level of control was noted as 128.0 x 10<sup>6</sup>/g and 4.0 x 10<sup>3</sup>/g for fungi and 4.0 x 10<sup>3</sup>/g for actinomycetes.

**Table 4: Microbial population of osmotic dehydrated coconut**

Particulars	Control (T <sub>0</sub> )	Acidified salt solution		Sugar solution		CD (P ≤ 0.05)
		Without antioxidants (T <sub>1</sub> )	With antioxidants (T <sub>2</sub> )	10° Brix (T <sub>3</sub> )	20° Brix (T <sub>4</sub> )	
Bacteria (x10 <sup>6</sup> /g)	7.0	3.0	3.0	4.0	4.0	0.13
Fungi (x10 <sup>2</sup> /g)	4.0	2.0	1.0	1.0	1.0	0.08
Actinomycetes (x10 <sup>3</sup> /g)	6.0	1.0	1.0	2.0	2.0	0.13

### CONCLUSION

It could be possible to process osmotically dehydrated coconut for both savoury and sweet dishes. Among the dehydrated samples, the sample treated with acidified salt solution with antioxidant and the sample treated with

20° Brix sugar solution had secured the highest score values during the study period. The shelf life of the dehydrated coconut can be extended by osmotic dehydration. The osmotic dehydrated coconut and ready-to-use

products are having high potential for commercialisation and marketability.

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