



Research Article

IDENTIFICATION OF SUITABLE DRYING METHODS FOR HIGH QUALITY DESICCATED COCONUT

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Received: October 01, 2020; Revised: October 19, 2020; Accepted: October 20, 2020; Published: October 30, 2020

Abstract: The grated coconut was dried by different methods of drying viz., sun, microwave and hot air oven (50°C). The quality parameters viz., colour, moisture, protein, fat, peroxide value, free fatty acid and organoleptic values were assessed. Based on the results, it was found that microwave oven drying was recorded as best method of drying to get good quality desiccated coconut which may be helpful to strengthen coconut industry in India and export value of value-added products of coconut.

Keywords: Blanching, *Cocos nucifera*, Desiccated coconut, Drying, Drying methods

Citation: P. Irene Vethamoni, *et al.*, (2020) Identification of Suitable Drying Methods for High Quality Desiccated Coconut. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 12, Issue 20, pp.- 10276-10278.

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Academic Editor / Reviewer: S K Shah, Dr D. T. Meshram, Dr G A Rajanna

Introduction

Coconut (*Cocos nucifera* Linn.) is one of the most important tree crops in the tropical regions of the world securing food and shelter for millions of people. Coconut is being grown in more than 93 countries around the world in an area of 11.95 million hectare with the production of 57,510 million coconuts annually.

Desiccated coconut is frequently added to curries and other savoury dishes. Theoretical Studies have been reported in the development of various types of driers for agricultural products [1]. Since drying temperature and methods are important aspects of processing of desiccated coconut, three different types of drying methods were conducted to optimize the best drying method to produce desiccated coconut with good quality.

Materials and methods

The fully matured coconuts were procured from RVS Padmathy College of Horticulture farm at Sempatti, Dindigul district, Tamil Nadu. The collected whole coconuts were de-husked and de-shelled. The de-shelling was done by a sharp knife to get the kernel out from the coconut shell and the kernel was disintegrated into smaller size (3 cm) using traditional coconut grater. The grated coconut was subjected to steam blanching for 3 minutes to reduce the microbial count. The blanched grated coconut was treated with salt at 1 percent concentration [2]. The salt treated grated coconut was dried by sun (3 and a half hours), hot air oven (50°C for 2 hours) and micro oven (Medium-low 25°C for 8 minutes) drying methods. The dried samples were cooled and packed in aluminium foil bags [3] and stored at ambient temperature of 30 ± 2°C. The moisture content of fresh grated sample was determined according to the method of Mohanraj and Chandrasekar [4]. The free fatty acid was expressed as percent of lauric acid [5]. The peroxide value was expressed as milliequivalents available oxygen kg⁻¹ (mEqO₂ kg⁻¹) of sample and calculated [5]. The data reported in the table is an average of seven observations and were subjected to one-way analysis of variance. The desiccated coconut samples were packed in aluminium foil bags sealed and stored in ambient room temperature at 30±2°C. The samples were evaluated for microbial count of bacteria and fungi at an interval of 0, 1, 2, and 3 months as per the procedure of Vendan [6] and expressed as colony forming unit (cfu g⁻¹).

The desiccated coconut samples were evaluated for their color and appearance, flavor, taste, texture, and overall acceptability by the panel members by nine-point hedonic scale for sensory evaluation [7].

Results and discussion

Desiccated coconut was obtained from drying of grated coconut after separating from the brown testa. The desiccated coconut has more shelf life and easy to transport than fresh coconuts.

Drying temperature and time

The results of the temperature needed for producing desiccated coconut and time taken for drying of grated coconut are presented in [Table-1]. Drying temperature is an important aspect of processing quality of copra.

Table-1 Effect of drying methods on drying temperature and time taken for the production of desiccated coconut

Particulars	Sun drying	Micro oven drying (Medium to low)	Hot air oven drying
Temperature	36°C	25°C	50°C
Time taken for grated coconut	3½ hrs	8 min	2½ hrs

Moses, *et al.*, (2013) [8] indicated that drying of food materials is an intricate phenomenon of simultaneous heat and mass transfer. Several studies have been piloted to emphasize the drying characteristics of fruits, vegetables, spices, oilseeds, nuts and their byproducts. The pursuit for alternative drying techniques to produce superior product quality is the imperative requirement of the desiccated coconut industry. The temperature and drying time to obtain grated coconut with 3 percent moisture was at 36, 25 and 50° C in three and a half hours, three minutes and two and a half hours by means of sun drying, microwave oven and hot air oven drying, respectively. It was found that microwave drying could be a potential alternative, owing to the numerous benefits it offers. This includes shorter drying time, better product quality, minimal heat losses, higher retention of flavor compounds, better rehydration and organoleptic characteristics. Drying rate was found to be very slow as compared to microwave oven and hot air oven drier due to lower heat and mass transfer coefficients.

A significant reduction in drying time was observed in microwave oven. Similar reduction in constant drying rate period is reported during microwave drying of chopped coconut pieces.

Quality analysis of desiccated coconut

Drying which involves the removal of water is a complex process. Varieties of dryers are used to dehydrate food products and the selection of drying method is based on the required quality of the final product. Desiccated coconut was assessed for quality characters and the data regarding them are presented in [Table-2].

Table 2 Effect of drying methods on quality characters of desiccated coconut
Values are mean $\pm$ SD of three replicates

Parameters	Sun drying (36° C)	Micro oven drying (Medium to low - 25° C)	Hot air oven drying (50° C)
Moisture (%)	3.6 $\pm$ 0.016	3.5 $\pm$ 0.016	3.7 $\pm$ 0.016
Free fatty acid	0.45 $\pm$ 0.01	0.41 $\pm$ 0.005	0.43 $\pm$ 0.005
Peroxide value	Nil	Nil	Nil

Moisture content

The moisture content of the desiccated coconut samples was recorded as 3.6 $\pm$ 0.016 percent followed by 3.5 $\pm$ 0.016 percent and 3.7 $\pm$ 0.016 percent viz., sun drying, microwave oven and hot air oven drying respectively [Table-2]. The moisture content is often used as an index of stability and quality. The results of this experiment are in close range with that of Samarajeewa (1985) who reported that the desiccated coconut contains moisture content of 2.7 percent.

Free fatty acid content of desiccated coconut

In hydrolytic reactions catalyzed by lipases of foods or microorganisms, the moisture and catalytic agents are the factors causing the hydrolytic rancidity and the free fatty acids formed on hydrolysis are due to fragmentation of long chain fatty acids to short chain fatty acids. Therefore, blanching was carried out to reactive the lipases. Due to excessive moisture, oil samples may be split into glycerol and component fatty acids by hydrolysis.

For monitoring, free fatty acid content the samples were tested by Cox and Pearson method and the data are presented in [Table-2]. It was found that the free fatty acid content of desiccated coconut samples was 0.45 $\pm$ 0.01, 0.41 $\pm$ 0.005 and 0.43 $\pm$ 0.005 for sun drying, micro oven and hot air oven, respectively. According to Sri Lankan standards for desiccated coconut, the total acidity of extracted oil from grated DC shall not be more than 0.3 percent (w/w), measured as lauric acid. The acidity value of present study of desiccated coconut samples are within the recommended limits.

Peroxide content of desiccated coconut

The degree of oxidation that has taken place in a fat or oil can be expressed in terms of peroxide value. When the double bonds of unsaturated fats become oxidized, hydro peroxides are formed as the primary products of oxidation. Upon standing these hydro peroxides may get fragmented leading to the formation of aldehydes, ketones and shorter chain fatty acids, which are responsible for the development of off-flavour.

In the present study, peroxide values of desiccated coconut samples were monitored and the sample peroxide value was not detected. This showed that there was addition of a salt and blanching of the samples and various other hygienic practices are also adopted in the process to safeguard the quality of the final product. Thus, the prepared desiccated coconut immediately was packed in various packing materials under airtight seal in order to minimize the exposure to oxygen. Hence, the samples were not susceptible to hydroperoxide formation. Peroxide value of coconut flour was within safe limits up to 4 months which keep up their peroxide value within the BIS (Bureau of Indian Standard) [10].

Microbial count

The total plate count of mean value of bacteria and fungi in desiccated coconut dried in different methods of drying and stored in aluminium foil is given in [Table-3]. There was no microbial growth in the treated samples after one month of storage period. After one month of storage period the microbial growth content

was gradually increased in sun drying method compared with hot air oven and micro oven drying method. The bacterial count in sun drying was found in $0.73 \pm 0.06 \times 10^7$, $1.31 \pm 0.06 \times 10^7$ and $2.02 \pm 0.11 \times 10^7$ and $0.85 \pm 0.10 \times 10^4$, $2.31 \pm 0.06 \times 10^4$ and $2.97 \pm 0.09 \times 10^4$ for fungi during storage period of one month, two and three months respectively. The microbial growth increased gradually over increase in storage period in sun drying. Microbial survival in commodities which have undergone processing is due to organisms which are adapted to survival at the extremes of the environment.

The properties of all dehydrated products are adversely affected by moisture. Spoilage in desiccated coconut was due to an accumulation of free fatty acids, aliphatic methyl ketones and secondary alcohols which gave the commodity a rancid off-flavour. The methyl ketones and secondary alcohols were formed from the coconut oil by growth at low water activity and oxygen tension of xerophilic fungi. But there was no bacterial and fungal growth in the desiccated coconut dried by microwave oven method until three months of storage.

Table-3 Effect of drying methods on microbial count of desiccated coconut
Values are mean $\pm$ SD of three replicates

Total plate count (cfu/g)		Storage period (months)			
		0 day	1	2	3
Sun drying	Bacteria	ND	$0.73 \pm 0.06 \times 10^7$	$1.31 \pm 0.06 \times 10^7$	$2.02 \pm 0.11 \times 10^7$
	Fungi	ND	$0.85 \pm 0.10 \times 10^4$	$2.31 \pm 0.06 \times 10^4$	$2.97 \pm 0.09 \times 10^4$
Hot air oven drying	Bacteria	ND	ND	ND	$0.22 \pm 0.04 \times 10^7$
	Fungi	ND	ND	ND	$0.32 \pm 0.04 \times 10^4$
Micro oven drying	Bacteria	ND	ND	ND	ND
	Fungi	ND	ND	ND	ND

Organoleptic quality

The aluminium foil packed stored desiccated coconut dried in different methods was stable over three months of storage at room temperature of $30 \pm 2^\circ\text{C}$ were evaluated for sensory attributes viz., colour, appearance, aroma, taste, texture and overall acceptability. The sensory attributes of the microoven desiccated coconut sample was found appreciably good compared with sun drying and hot air oven drying desiccated coconut. Similar results with no difference of flavor was detected between bread made with 0-4 months of stored dehydrated coconut [11,12].

Table-4 Effect of drying methods on sensory attributes of desiccated coconut
Values are mean $\pm$ SD of the scores obtained

Parameters	Sun drying	Hot air oven	Micro oven
Colour & Appearance	6.00 $\pm$ 1.82	6.85 $\pm$ 1.34	8.14 $\pm$ 0.37
Aroma	5.85 $\pm$ 2.11	6.42 $\pm$ 1.61	8.00 $\pm$ 0.57
Taste	5.57 $\pm$ 1.61	6.28 $\pm$ 1.11	7.85 $\pm$ 0.89
Texture	6.14 $\pm$ 1.21	6.71 $\pm$ 1.70	7.85 $\pm$ 0.69
Overall acceptability	5.57 $\pm$ 1.13	6.71 $\pm$ 1.25	8.28 $\pm$ 0.48

Conclusion

Based on the qualitative results it was found that there is significant difference between the drying methods on the desiccated coconut samples and the quality was found to be best by drying in microwave oven method than other drying methods. It was found that microwave drying could be a potential alternative, owing to the numerous benefits it offers.

This includes shorter drying time, better product quality, minimal heat losses, higher retention of flavor compounds, better rehydration and organoleptic characteristics. This microoven drying technology will be more helpful for the industrialist and small-scale farmers to produce desiccated coconut in a short time with good quality.

Application of research: Desiccated coconut is suitable for long term storage with extended shelf life. It is product highly suitable for export market.

Research Category: Post Harvest Technology

Abbreviations: ND- not detected; SD- standard Deviation

Acknowledgement / Funding: Authors are thankful to RVS Padmavathy College of Horticulture, Sempatti, 624707, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India.

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University: Tamil Nadu Agricultural University, Coimbatore, 641003, India

Research project name or number: Research station study

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Sempatti, Dindigul District, Tamil Nadu

Cultivar / Variety / Breed name: Coconut (*Cocos nucifera* Linn.)

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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