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Storage Stability of Grated and Milled Desiccated Coconut Meat

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Abstract: Demand for coconut flavoured bread is on the increasing path due to consumers' preference for natural and healthy bread additives. Bakers in other to meet the increased demand have to store pre-processed coconut meat for some time prior to use. This work studied the storage stability of grated and milled desiccated coconut meat. Two samples of coconut meat were respectively milled and grated dehydrated and, stored of 25±5°C for 5 months in vacuum sealed transparent low density polyethylene bags. Samples were evaluated at the interval of 0, 1, 2, 3, 4 and 5 months for chemical and sensory indicators of quality using standard methods of analysis.Neither the milled or grated sample showed significant increase in peroxide value (PV) before the 4th month. The milled coconut showed significant increase in FFA, which was likely due to the rupture of more oil bearing cells. A trained sensory panel could not detect any difference in the odour properties of fresh or stored grated coconut sample. No difference in flavour could be detected between bread made with 0 – 4 months grated desiccated coconut. This study showed that grated dehydrated coconut can be stored for 5 months at ambient temperature without noticeable changes in quality with respect to milled dehydrated coconut (4 months). The result of this study will be helpful to the policy makers including National standards organisations and the regulatory agencies.

Key words: Oxidation · Oil · Bread

INTRODUCTION

Coconut (*Cocos nucifera*) is one the most important crops grown in the humid tropics. More than 11 million farmers, mostly smallholders with low income, grow the palm in 90 countries and more than 80% of the total world production comes from the Asia–Pacific countries, which are near neighbours of Australia.With these data according to Mwachiro [1] the coconut industry could be said to well establish Tanzania (With an output of 5 million tonnes) is the only African country listed by the FAO (2013) among the ten top most coconut producing countries of the world with a combined total of 62 million tonnes annually. Coconut has a number of commercial and traditional cultivars [2]. Coconut has been identified as a significant source of edible oil and as an agro-based raw material for many industries such as manufacture of shell powder and handicrafts. The various parts of the coconut have a number of culinary uses. The seed provides oil for frying, cooking and making margarine. The white, fleshy part of the seed, the coconut meat, is used fresh or dried in cooking, especially in confections and desserts such as macaroons. The humankind is continually finding coconut palm and its produce very useful in all facets of life including culture and religion, beauty. The medicinal values of coconut tested in animals have highlighted by Core [3], De Lourdes Arruzazabala *et al*. [4], Khonkarn [5], Campbell-Falck [6], Rajkumar and ThamilSelvan [7], Sulochana [8] and Official methods and Recommended Practices of The American oil Chemists' Society [9].

Desiccated coconut or coconut milk made from it is frequently added to curries and other savoury dishes. Coconut flour has also been developed for use in baking, to combat malnutrition.The use of desiccated coconut in the bakery product as ingredient has become progressively more widespread. Inclusion of up to 5 to 8% by weight of grated desiccated coconut in bread formulations, besides reducing the quantity of sugar, results in an acceptable product. Coconut flour obtained

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by partially defatting desiccated coconut under mild expelling conditions may be incorporated into breads. The removal of the residual oil (Fat free) in the flour including the use of the solvent excellently improves the keeping properties of the flour.

Coconut flour obtained by partially defatting desiccated coconut meat under mild expelling conditions may be incorporated into breads. The flour could keep for longer period of time without undergoing oxidative spoilage if the residual oil (Fat free) in it is removed by acceptable means including the use of food grade solvent. One of the major challenges in the processing and application of desiccated coconut flour is the propensity and proneness to high level of microbial infection. However, the subsequent introduction of pasteurization during the processing line had considerably reduced the health concerns.

The major challenge associated with the use of this product is that all the bakeries cannot produce the desiccated coconut in the bakery facility due to the high of transporting whole coconut from the farm or market to the factory site and stringent production conditions. According to Taffin [2] 17.2 tonne of whole coconut will occupy a volume of 83 cubic metres but when processed into copra it will be reduced to just 3.3 tonnes and 11 cubic metres. Great savings in storage space and transportation cost. The undehusked coconut maybe stored for longer time, whereas the copra must processed or used immediately hence there should be a trade-off between processing at a central facility and processing at the bakery factory. This means that the bakeries for example have to buy prepared desiccated coconut from the processors and store until used. It is generally believed that grated or milled desiccated coconut has limited shelf life.

Thus the objectives of this study were to determine and compare the stability of grated and milled desiccated coconut stored at ambient temperature, 25±4°C as bread baking additive and, measure the oxidative stability using chemical and sensory methods.

MATERIALS AND METHODS

A mixture of sample of the coconut varieties grown in Nigeria were used in this study. These samples were used because it is very difficult to obtain a particular variety in a steady supply.

The coconut were processed according to the method of Obibuzor 2014 (Personal communication): dehusked, spilt, shelled, grated or milled, steamed, desiccated and packed under vacuum in a translucent low density polyethylene bags (1kg) and sealed and stored in a room at 2±4°C.

Experimental Design: This experiment was designed in such a manner that all the stored samples were ready for analysis at the same time. In other words, the sample to be stored for the longest time (150 days) were first processed and stored. Then thirty days later the samples for the 120 days were processed and placed in storage, this procedure was followed for other storage intervals. In order to be sure that this procedure was not compromised, he coconut samples were sorted prior to processing.

Chemical Analysis of the Grated and Milled Samples: Oil was extracted from the grated and milled desiccated coconut according to American Oil Chemists'Society (AOCS) method Am 2-93. Peroxide values of the extracted oil were determined according to AOCS method Ca 5a-40 and free fatty acids were determined by PORIM test method. Fatty acid composition of the extracted oil was determined using AOCS Method Ca 5a-40. All analyses were carried out in duplicates.

Sensory Evaluation: A seven member panel evaluated the grated and milled desiccated coconut on its odour characteristics. The sensory evaluation was performed by using (AOCS method Cg2-83). Samples were coded with three digit random numbers and were presented in random orders to panellists. The panellists rated the intensity of fresh odour on the five point category scale where 1=none and 5= strong. A fresh (zero day) grated and milled desiccated coconut were respectively provided as the reference at each test session. Due to the number of samples generated, four test sessions were required to evaluatethe entire samples and their replications.

Sensory Evaluation of Bread: Bread was made from the grated and milled desiccated coconut samples that had been in storage for zero and 150 days. The bread was produced in a Standard automated bakery, G9 bakery Limited, Gagwalada, Abuja, Nigeria. It was produced by replacing 5% by weight of sugar and 2% by weight of bakery fat (7%) with grated and milled desiccated coconut respectively in the G9's standard formula. After baking, the bread (4 loaves was allowed to cool at ambient temperature, packed in the standard low density polyethylene without label, transferred into a chest and

transported to the Biochemistry Division, NIFOR, Benin City, where they were stored in a deep freezer at –4°C until required for analysis. On the day of evaluation, the loaves of bread were removed from the freezer 3 h prior to analysis. A panel of 40-participants mainly 500 level undergraduate students from the Ambrose Alli University, Ekpoma, Edo State, Nigeria and the University of Benin, Benin City, Edo State, Nigeria, who volunteered to serve on the panel, evaluated the bread for flavour. The task of the participants was to choose the sample that had the same flavour as the reference. Bread was prepared for evaluation by removing the crusts, cutting the slices into 4x4x2 cm cubes and placing the cubes in 100-ml plastic cups with lids.

Statistical Analysis: Analysis of variance using the general linear model was used to analyse data from chemical and sensory test. The model included the main effects of sample and storage days and its interaction. The method described by Meilgaard was used to analyse the data generated from the duo-trio sensory (Bread) evaluation.

RESULTS AND DISCUSSION

Quality of Whole Fresh Coconut: Table 1 shows the composition of the dehydrated coconut samples. There was no significant difference in the compositions.

The coconut sample used was considered to be of excellent state considering quality of the extracted oil (Zero day) as indicated by the free fatty acid content, peroxide value, moisture and dirt (Table 2). There was significant increase in the Peroxide value level of the milled sample beginning from the ninetieth day with a corresponding increase in the anisidine value, but in the case of the grated sample there was no significant increase in PV level. This result suggests that milling ruptures more oil bearing cells and predisposes it to oxidation when compared to grating. Consequently, grated coconut keeps longer than the milled sample. There were no significant changes in the other physical and chemical characteristics carried out on the extracted oil. Overall, the trend was that, as the storage period increased, the level of free fatty acid increased in the milled sample, but the level in the grated sample did not change. A significant ($P<0.5$) interaction between free fatty acid and the length of storage was observed. The increased free fatty acids level maybe due to the activity of the exogenous enzymes due to the largely

Table 1: Composition of the dehydrated coconut

	Grated	Milled
Moisture,%	3.01	2.98
Oil %	64.45	65.01
Non Fat Solids% (by difference)	32.54	32.01

Table 2: Physico-chemical Quality Characteristics of the extracted oil

	Grated, storage day						Milled, Storage day					
	0	30	60	90	120	150	0	30	60	90	120	150
Density	0.933±0.03	0.933±0.03	0.936±0.03	0.933	0.936	0.931	0.933	0.932	0.934	0.937	0.935	0.937
Viscosity	0.34±0.03	0.35±0.01	0.35±0.01	0.37±0.02	0.40±0.01	0.41±0.03	0.35±0.04	0.35±0.03	0.36±0.02	0.4±0.03	0.44±0.02	0.49±0.01
Refractive index	1.4502	1.4502	1.4501	1.4502	1.4504	1.4500	1.4502	1.4501	1.4506	1.4502	1.4508	1.4507
Melting ° C	22-26	23-26	22-26	25-30	22-27	24-28	22-26	23-26	22-26	21-25	22-26	23-27
Moisture %	0.10±0.03	0.11±0.03	0.09±0.02	0.17±0.01	0.13±0.01	0.15±0.03	0.12±0.04	0.15±0.03	0.15±0.01	0.18±0.01	1.51±0.02	1.64±0.02
Free Fatty Acid (FFA) %	0.21±0.03	0.39±0.03	0.59±0.03	0.71±0.03	1.01±0.03	1.62±0.03	0.30±0.03	0.53±0.03	1.60±0.03	2.50±0.01	2.7±0.02	3.10±0.03
Peroxide Value (PV)Meq O2/Kg oil	0.50±0.03	0.52±0.03	0.56±0.01	0.64±0.01	0.67±0.02	0.74±0.03	0.61±0.01	0.71±0.01	0.77±0.03	1.55±0.01	3.30±0.03	3.6±0.03
Anisidine value (AnV) Meq O2/Kg	0.32±0.03	0.34±0.03	0.38±0.03	0.38±0.02	0.42±0.04	0.47±0.02	0.34±0.01	0.37±0.02	0.45±0.02	0.67±0.03	0.56±0.01	0.81±0.03
Totox (2PV+ AnV)	1.02	1.38	1.50	1.66	1.76	1.95	1.56	1.79	1.99	3.77	7.16	8.01
Saponification value (SV) mg KOH/Kg	260.4±0.01	258.5±0.03	262.1±0.01	257.9±0.00	261.0±0.03	260.3±0.03	261.7±0.02	260.2±0.03	259.7±0.01	260.8±0.01	260.7±0.01	262±0.03
Iodine Value (IV)	7.90±0.02	7.83±0.03	7.55±0.04	7.46±0.03	7.35±0.01	7.10±0.03	7.66±0.02	7.72±0.01	7.28±0.01	6.92±0.02	6.75±0.03	6.69±0.02
Colour (Y+5R)	3	3	3	3	4	4	3	4	4	4	5.3	6.0

Y= Yellow, R=Red

Table 3: Fatty Acid Composition of the extracted oil

Fatty acid	Grated	Milled
Caproic, C6:0	-	-
Caprylic, C8:0	5.09±0.02	4.78±0.01
Capric, C10:0	7.12±0.01	6.78±0.03
Lauric,C12:0	50.05±0.03	50.01±0.04
Myristic,C14:0	20.12±0.01	19.89±0.01
Palmitic,C16:0	6.03±0.01	6.02±0.02
Stearic,C18:0	2.10±0.02	2.30±0.01
Oleic,C18:1	5.21±0.02	4.97±0.02
Linoleic	-	-

bruised nature of the sample from the milling process. There were no noticeable discolorations in the grated or milled coconut samples.

Table 2 shows that lauric and myristic acid were the predominant fatty acids.

Sensory Evaluation of Bread: The number of panellists who correctly identified the sample that was the same as the reference was 32 out of 40 for the bread containing the dehydrated coconut and 19 out of 40 for the bread containing milled coconut. The result was significant ($P<0.05$), indicating that the panellists were unable to detect a flavour difference between bread made with 0 day stored dehydrated coconut and 150-day stored dehydrated coconut. In the case of milled coconut the result was significant ($P<0.05$), indicating that the panellists were able to detect a flavour difference between bread made with 0 day stored milled coconut and 150-day stored milled coconut.

The grated stored dehydrated coconut was stable over 150-day of storage at 29±4°C as monitored by the peroxide values of the oil extracted from the samples and sensory evaluation, while milled dehydrated coconut displayed an onset of peroxidation 120-day storage period. These findings suggest that milling process ruptures the oil bearing cells hence exposing more oil which has the propensity to undergo oxidation compared to the largely ruptured counterparts in the grated.

CONCLUSION

With respect to the values of PV, both the milled and grated desiccated coconut meat was stable over 90 days of storage but the grated went well beyond 90 days. The baker must use up the stock of milled dehydrated coconut within 90 days of purchase in order to ensure the wholesomeness of the product. The result could be used to monitor the quality of the dehydrated coconut prior to use.

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