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Proximate and Vitamin Composition of Fresh and Canned *Calocybe indica* P & C during Storage

***Apotiola, Z.O., **Anyakorah, C. I. and **Kuforiji, O. O.**

*Department of Food science and Technology, Lagos State University of Science and Technology, Ikorodu, Lagos. **Department of Biological Sciences, Bells University of Technology, Ota, Ogun State.

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Abstract

The nutritional and vitamins composition of canned *Calocybe indica* (milky mushroom) was evaluated. The mushroom was grown under control environment with sawdust (*Cola nitida*) and rice bran substrate (4:1) canned in brine solution of salt and citric acid. Analysis were carried on proximate composition, water soluble and fat soluble using standard methods. The moisture, protein, ash, crude fibre, fat and carbohydrate contents (mg/100g) sample varied from 88.17± 0.01 - 93.67± 0.01, 1.28± 0.03- 3.96± 0.02, 0.33±0.03- 1.02± 0.05, 0.21±0.03- 0.63±0.03, 1.73±0.03- 2.66±0.05 and 2.78± 0.04- 3.53± 0.04 respectively. While fat soluble vitamins A, D, E and K varies from 0.06±0.04 – 0.13±0.05, 0.53±0.05 – 0.59±0.02, 0.14±0.03 – 0.32± 0.03 and 0.00±0.00 - 0.03± 0.05 respectively and water soluble vitamins of vitamin B1, B2, B3, B5, B6, B12 and C varies from 0.12±0.02- 0.14±0.00, 0.75± 0.07 - 0.95±0.02, 0.15±0.06 - 0.26±0.01, 0.10± 0.02 – 0.15±0.01, 0.05±0.07 – 0.10±0.00, 0.02±0.05 – 0.10±0.00 and 0.19±0.99 – 0.53±0.03 respectively. The values recorded for fresh *C.indica* were the highest and lowest after one year of storage for the canned

products. The properties of the canned product were relatively stable for the period of one year.

Introduction

Mushrooms are the edible fungi prized for their delicacy and distinctive flavor. Because of their unique nutritional status they are known as "the ultimate health food". The Greeks and Romans described mushrooms as "Gift of God" and were served only on festive occasions (Rai *et al.,* 2005). Mushrooms have been considered as ingredient of gourmet cuisine across the globe; especially for their unique flavor and have been valued by human kind as a culinary wonder. More than 2,000 species of mushrooms exist in nature, but around 25 are widely accepted as food and few are commercially cultivated. Mushrooms are considered as a delicacy with high nutritional and functional value, and they are also accepted as nutraceutical foods; they are of considerable interest because of their organoleptic merit, medicinal properties, and economic significance (Chang and Miles, 2008; Ergonul *et al.,* 2013). However, there is not an easy distinction between edible and medical mushrooms because many of the common edible species have therapeutic properties and several used for medical purposes are also edible (Guillamon *et al.,* 2010). The objective of the study is to investigate the effect of canning operations on nutritive factors in fresh and canned *C. indica.*

Materials and Methods

Materials

The study was done by utilizing rice bran and sawdust for the cultivation of milky mushroom. Other materials used include polypropylene bag, $CaCo_3$, water, brine solution (common salt and citric acid at varying ratios 2.0:1.5, 2.5:1.5, 3.0:1.5 ,3.5:1.5), tin cans and corrugated cardboard cartons. Cultivation and canning processing by the procedure prescribed in Figures 1and 2.

Samples analysis: Proximate composition was determined by AOAC (2015) methods, the water soluble vitamins were determined by the method prescribed by Onyeka *et al*., 2015 and fat soluble vitamins were determined following the procedures by Kang, 2007

Statistical Analysis

Data were subjected to the analysis of variance (ANOVA) using SPSS program (version 16) and the treatment means separated using Duncan multiple test. Significance was accepted at $p<0.05$.

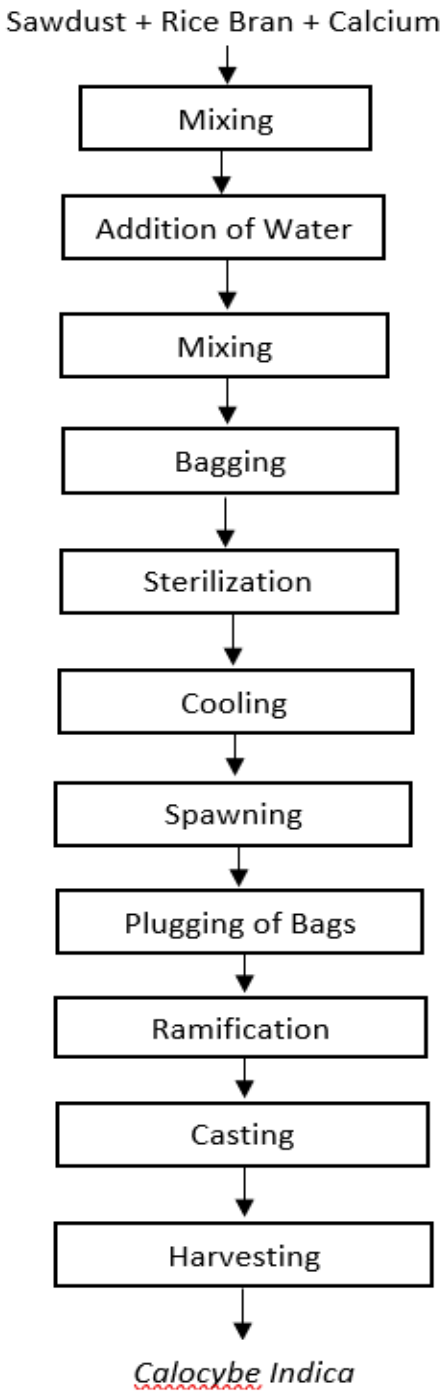

Figure 1: Flow chart for the cultivation process of *Calocybe indica*

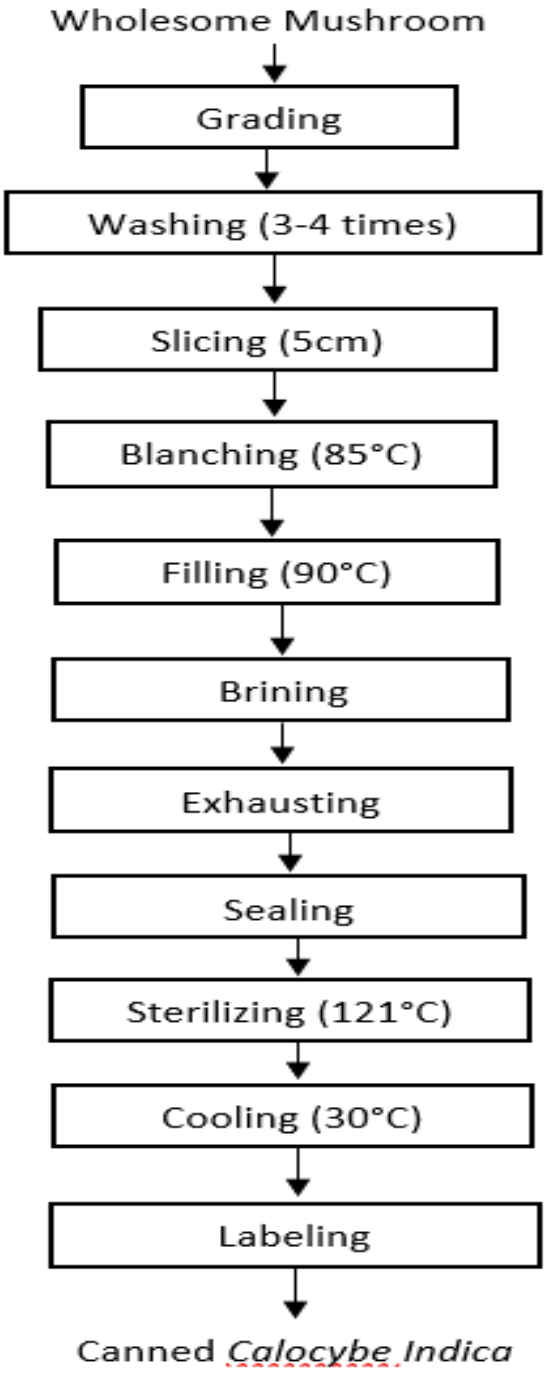

Figure 2: Flowchart for the canning process of *Calocybe indica* mushroom.

Source: Thakur, 2016

Results and Discussion

Proximate Composition of Canned *Calocybe Indica* over a Period of Six Weeks and One Year

The proximate composition of the canned *Calocybe indica* over a period of six weeks and one year is presented in Table 1. The moisture contents ranged from 88.17-94.02%. The highest value was obtained in sample AOY (sixth week) while the lowest value was recorded in sample FMR (fresh) C*alocybe indica*). There was significant difference ($p<0.05$) between the samples. This study showed that the moisture content of the canned mushroom increased over the period of days. In contrast to this present study, Ijioma *et al.* (2015) reported loss in moisture content of fresh mushroom samples stored for 3 days. The high moisture content obtained in this study is expected because of the brine medium and which will lead to increase in the perishability of the samples. Moisture contents ranging from 85.4-94.7% has also been reported by Manzi *et al.* (2005). These values were similar to the present study. Mushrooms have been reported to have high moisture contents, indicating that they are highly perishable and susceptible to microbial growth, rapid deterioration and enzyme activity (Adejumo and Awosanya, 2005).

The protein content ranged from 5.40 – 6.34%. Sample fresh had the highest value of protein while sample STC (sixth week) had the lowest value. The protein content of the mushroom reduced over the period as a result in increase in the moisture content. Edible mushrooms are considered to be a richer source of protein as compared to green vegetables. The protein content of mushrooms depends on a number of factors such as substrate composition, pileus size, harvest time, and the species of mushrooms (Onyeka *et al.,* 2009). Zahid *et al.* (2010) recorded the value (3.22%) for *Calocybe indica*. This value was similar to this present result.

Sample FMR (fresh *Calocybe indica*) with the value 1.02% was next to fresh. Sample STC (sixth week) had the lowest value of 0.33%. There was significant difference ($p<0.05$) between the values. Researchers have reported that mushrooms are rich in mineral content and can act as a better source of minerals than vegetables (Onyeka *et al.,* 2009). The ash content of the canned *Calocybe indica* reduced as the days increased. The ash obtained in this study was lower than (2.30%) for *Calocybe indica* reported by Zahid *et al.* (2010). Mushrooms are valuable sources of dietary fibre (Chandravadana *et al.,* 2005). The fibre content ranged from 0.21-0.63%.

The highest value was recorded in sample FMR (fresh mushroom) while the lowest value was found in sample STC (sixth week). There was significant difference ($p<0.05$) between the samples. The studied mushrooms they could be regarded as good sourse of dietary fibre. Since the studied mushrooms contain high amount of fibre with the associated health benefits. Mushrooms have no cholesterol and are virtually low in fat. The fat content of edible mushrooms consists mostly of unsaturated fatty acids, which are less hazardous to the health than the saturated fatty acids of animal fats (Chandravadana *et al.,* 2005). For fat, the highest value (0.47%) was recorded for sample fresh. The lowest value (0.42%) was observed in sample AOY (after one year). There was significant difference ($p<0.05$) between all the samples. Interestingly, the fat contents obtained in this study were low. This implies that *Calocybe indica* can function effectively in low fat diet such as those required by patients with cardiovascular diseases, obesity etc (Grodzinskaya *et al.,* 2003). The value of carbohydrate ranged from 2.78-3.74%. The highest value was recorded in sample FWK (first week) while the lowest value was observed in sample STC (sixth week). There was no significant difference ($p>0.05$) between the samples. The value of carbohydrate in this study was lower when compared with the values (4.24-6.38%) reported by Zahid *et al.,* (2010) for fresh edible mushrooms. The decrease experienced was as a result of increase in the moisture content which leads to correspondence decrease fat and carbohydrate contents.

Vitamin Composition

The Vitamin B1 content ranged from 0.13-0.14 mg/100g. Sample FWK had the highest content (0.14 mg/100g) while sample STC had the lowest content (0.13 mg/100g) of Vitamin B1 content. The Vitamin B2 content ranged from 0.86-0.95 mg/100g. Sample FRM had the highest value of 0.95 while sample STC had the lowest value of 0.86 for Vitamin B2. The value observed in sample FRM is similar to the value (0.94 mg/100g) reported by Fredrick *et al.* (2013) for an indigenous mushroom in Kenya. The B vitamins are essential nutrients that support carbohydrates metabolism, enhance immune system function, and promote cell growth (Adejumo, 2012). The contents of Vitamin B3, B4 and B6 ranged from 0.19-0.26 mg/100g, 0.11-0.15 mg/100g and 0.07-0.10 mg/100g respectively. The lower amount of Vitamin B3 (0.19 mg/100g), B5 (0.11 mg/100g) and B6 (0.07 mg/100g) were obtained in sample STC while the higher amount of Vitamin B3 (0.26 mg/100g), B5 (0.15 mg/100g) and B6 (0.10 mg/100g) found in sample FWK.

The lower amount obtained in sample STC shows that canning has effect on milky mushroom which is similar to Nouri *et al.* (2018).

Table 1: Proximate Composition of Fresh and Canned Mushroom

SAMPLE	Moisture (%)	Protein (%)	Total Ash (%)	Crude Fibre (%)	Fat (%)	Carbohydrate (%)
FRM	88.17±0.01^{d}	6.34±0.03^{d}	1.02±0.05^{d}	0.63±0.03^{e}	0.47±0.05^{b}	3.83±0.04^{e}
FWK	91.33±0.00^{c}	5.74±0.01^{c}	0.46±0.06^{b}	0.29±0.02^{c}	0.42±0.04^{a}	3.74±0.02^{d}
SWC	91.15±0.05^{c}	5.77±0.04^{c}	0.45±0.03^{b}	0.28±0.01^{c}	0.41±0.05^{c}	3.69±0.02^{d}
TWK	91.67±0.04^{b}	5.66±0.03^{b}	0.44±0.05^{b}	0.27±0.03^{c}	0.42±0.01^{a}	3.61±0.01^{d}
FWC	92.25±0.01^{b}	5.63±0.04^{b}	0.43±0.02^{b}	0.26±0.04^{c}	0.44±0.02^{a}	2.93±0.03^{b}
FFC	92.67±0.05^{b}	5.70±0.02^{c}	0.39±0.01^{b}	0.24±0.01^{bc}	0.43±0.03^{a}	3.17±0.02^{c}
STC	93.67±0.05^{a}	5.64±0.03^{b}	0.33±0.03^{a}	0.21±0.03^{a}	0.44±0.03^{a}	2.78±0.04^{a}
AOY	94.02±0.02^{a}	5.40±0.00^{a}	0.32±0.02^{a}	0.19±0.01^{a}	0.42±0.32^{a}	2.70±0.02^{a}

*Mean ± standard deviation of 2 replications. Means with same superscripts in a the column are not significantly different at (p>0.05)

LEGEND

FMR Fresh *Calocybe indica*
BLM Blank *Calocybe indica*
FWR First Week
SWK Second Week
TWK Third Week
FWC Fourth Week
FFC Fifth Week
STC Sixth Week
AOY After One Year

Vitamin B6 is involved in the generation of neurotransmitters in the brain and nervous system (Combs, 2007). The content of vitamin B12 ranged from 0.03-0.10 mg/100g. For Vitamin B12, the higher value (0.10) was obtained in sample FWK while the lower value (0.03) was obtained in sample STC. The values obtained in this study were lower than the value (0.30) reported by Frederick *et al.* (2013) for an indigenous mushroom in Kenya. The value of Vitamin C ranged from 0.23-0.53 mg/100g. Sample FRM had the highest value of 0.53 for vitamin C while sample STC had the lowest value of 0.23 mg/100g. The lower amount observed in this samples is in line with the value by Mattila *et al.* 2001, who reported that mushroom contain small amounts of vitamin C: usually up to 7 mg/100g of edible parts.

The vitamin A content ranged from 0.07-0.13 mg/100g with sample FRM having the highest value while sample STC has the lowest value. Vitamin A is a fat-soluble vitamin obtained both from plant and animal sources. Vitamin A from

animal sources is known as retinoid, whereas, the vitamin A from the plant source is called pro vitamin A carotenoids (Cho, 2016). The Vitamin D content ranged from 0.54-0.59 mg/100g. Sample FRM had the highest value while sample STC had the lowest value. The value in this study was lower than the value (35.0 micro gram) reported by Emilia *et al.* (2006) who worked on edible mushrooms as a source of valuable nutritive constituents. The content of Vitamin E ranged from 0.19-0.32 mg/100g. The higher amount (0.32) of Vitamin E was in sample FRM while the lower amount (0.19) was in sample STC. Vitamin E shields the body structures from oxidative damage (Meydani *et al.,* 2005).

Table 2: Water Soluble Vitamins content of Fresh and Canned Stored *Calocybe indica*

Sample	Vitamin B1	Vitamin B2	Vitamin B3	Vitamin B5	Vitamin B6	Vitamin B12	Vitamin C
FRM	0.14±0.00^a	0.95±0.02^b	0.26±0.01^b	0.15±0.01^a	0.10±0.00^a	0.10±0.00^a	0.53±0.03^b
FWK	0.13±0.00^a	0.86±0.01^a	0.19±9.01^a	0.11±0.01^a	0.07±0.06^a	0.03±0.06^a	0.23±0.03^a
SWC	0.13±0.02^a	0.85±0.05^a	0.18±0.04^a	0.10±0.05^a	0.06±0.04^a	0.03±0.02^a	0.21±0.05^a
TWK	0.12±0.05^a	.76±0.06^a	0.17±0.07^a	0.11±0.02^a	0.06±0.05^a	0.03±0.04^a	0.20±0.08^a
FWC	0.12±0.04^a	0.76±0.04^a	0.17±0.04^a	0.11±0.00^a	0.06±0.03^a	0.02±0.07^a	0.20±0.04^a
FFC	0.12±0.05^a	0.75±0.05^a	0.16±0.03^a	0.10±0.07^a	0.06±0.02^a	0.02±0.07^a	0.20±0.05^a
STC	0.12±0.02^a	0.75±0.07^a	0.15±0.06^a	0.10±0.02^a	0.05±0.07^a	0.02±0.05^a	0.19±0.99^a

*Values are means ± standard deviation of 2 replications. Means with same superscripts within a column are not significantly different at (p>0.05)

Table 3: Fat Soluble Vitamins of Fresh and Canned Stored *Calocybe indica*

Sample	Vitamin A	Vitamin D	Vitamin E	Vitamin K
FRM	0.13±0.05^b	0.59±0.02^a	0.32±0.03^b	0.03±0.05^a
FWK	0.07±0.05^a	0.54±0.01^a	0.19±0.03^a	0.00±0.00^a
SWC	0.07±0.02^a	0.53±0.05^a	0.19±0.02^a	0.01±0.00^a
TWK	0.07±0.05^a	0.54±0.04^a	0.18±0.05^a	0.00±0.00^a
FWC	0.07±0.04^a	0.55±0.00^a	0.17±0.03^a	0.00±0.01^a
FFC	0.06±0.05^a	0.54±0.03^a	0.16±0.05^a	0.00±0.00^a
STC	0.06±0.00^a	0.54±0.04^a	0.14±0.03^a	0.00±0.00^a

*Values are means ± standard deviation of 2 replications. Means with same superscripts within a column are not significantly different at (p>0.05)

The value for Vitamin K ranged from 0.00-0.03 mg/100g. For vitamin K, sample STC had no Vitamin K while sample RW2 had low amount of 0.03 mg/100g. Vitamin K is essential for blood clotting activity, helps in the maintenance of bone health by keeping demineralization under control (Shearer *et al.,* 2012; Shearer and Newman, 2014; Atkins *et al.,* 2009).

Conclusion

The results shows that there were siginificant differences in the nutritional composition, water and fat soluble vitamins contents ($p<0.05$) for all the parameters tested for fresh and canned mushroom samples. However, the changes in the canned samples were not significant as they were stable. In addition moisture and carbohydrate contents of the canned mushroom increased on storage.

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