Malaya Journal of Biosciences 2018, 5(1):37-43
ISSN 2348-6236 print /2348-3075 online

Malaya Journal of Biosciences

www.malayabiosciences.com

RESEARCH ARTICLE

Open Access Full Text Article

Shelf Life Assessment of Chutney Powder Developed from *Calocybe indica* (Milky Mushroom)

Jawahar Ganapathy* and Emilin Renitta

[1]*Assistant Professor, C.G. Bhakta Institute of Biotechnology, UkaTarsadia University (Maliba Campus), Gopal Vidyanagar, Bardoli-Mahuva Road, Tarsadi - 394350. Surat District, Gujarat, India.*
[2]*Assistant Professor (SG), Department of Food Processing and Engineering, Karunya University, Karunya Nagar, Coimbatore - 641 114, Tamil Nadu, India.*
**For correspondence E-mail: drjawaharphd@gmail.com*

Article Info: Received 11 Jan 2018; Revised: 24 March 2018; Accepted 02 April 2018.

ABSTRACT

The present study revealed that the value added products developed from *Calocybe indica (C.indica)* had good storage period, nutritive value. As months progressed, the biochemical composition of C. *indica* chutney powder was found to be decreased when compared to the initial levels. A gradual increase in total plate count was observed for the product during storage period. No remarkable changes were observed for organoleptic characteristics of chutney powder prepared from *C.indica*. The sensory scores of chutney powder remained within the acceptable limit throughout the storage period. The overall acceptability of products ranged from 8.5±0.21 to 7.1±0.31 during the storage period. No spoilage occurred during the storage period. This could be the preservative action of ingredients on food products till the 6th month of storage period. Based on observations, it was found that the value added products would be included as a regular diet, since it possess rich nutritive value. Thus the present study had proven that these edible mushrooms products could find a place in the domestic market on par with other functional foods.

Keywords: Mushroom, chutney powder, shelf life assessment, *Calocybe indica,* nutritive value

1. INTRODUCTION

Good nutritive food makes to function well physically and mentally and at the same time unhealthy diet gives rise to several disorder in the body. A well-balanced, nutritive and correct food is thus of utmost importance source for the maintenance of good health and the healing of diseases. Such diets should be made up of rich nutritious foods, which in combination would supply all the essential nutrients [1]. Chutney powder is a popular, ready to serve and convenience food - products in India, commonly prepared using cereals and pulses. Chutney powder is a very tasty dish especially prepared in Southern India. They are excellent spice powders that can also be used as a spread on sandwiches, dosa or on chapatti, everyone can take for lunch or picnic if they don't want to mess their tiffin box or packaging material with wet curry or gravy dishes [2]. In the present study *C. indica* powder was incorporated with some other ingredients to

prepare chutney powder. The shelf life assessment of the products stored in PET jars at ambient temperature (30±2˚C) were assessed in order to utilize the good mushroom resources

2. MATERIALS AND METHODS

2.1 Formulation ratio of C.indica chutney powder

T-1 chutney powder made by 15 % mushroom powder + 85 % Black gram

T-2 chutney powder made by 20 % mushroom powder + 80 % Black gram

T-3 chutney powder made by 25% mushroom powder + 75 % Black gram

T-4 chutney powder made by 30% mushroom powder + 70 % Black gram

T-5 chutney powder made by 35% mushroom powder + 65 % Black gram

The mushrooms powder was incorporated with some other ingredients and chutney powder were prepared according to the formulation ratio described above [3]. Based on sensory evaluation, the chutney powder made out of 30 % mushroom powder was used for storage studies (Figure 1 and 2).

Figure 1. Mushroom chutney powder developed from *C.indica*

2.2 Estimation of biochemical composition

The protein estimation of *C.indica* was carried out by following the method of Lowery [4]. Determination of total carbohydrate for *C.indica* was carried out by following the method of Somani 1987[5]. Determination of total lipid for *C.indica* was carried out by following the method of Akins 1989 [6]. Determination of crude fiber for *C.indica* was carried out by following the method of Lipiec 1994 [7]. Determination of total ash for *C.indica* was carried out by following the method of Cuddeford & Hughes [8]. The Free fatty acids value for the products was carried out by following the method described [9]. The pH for the product was carried out by the following the method of Neill [10]. Enumeration of Total Plate count (TPC) for the products was carried out by following the method of Feldsine [11].

Figure 2. Mushroom chutney powder stored in pet jars

2.2 Sensory analysis

The organoleptic characteristics of all the products were carried out by following the method of Menon [12]. The sensory attributes including taste, colour, texture, flavor and overall acceptability were evaluated by a trained 20-member panel. The panelists were asked to evaluate the products for appearance, colour, taste, crispiness, aroma and overall acceptability. The ratings were on a 9-point hedonic scale, ranging from 9 (like extremely) to 1 (dislike extremely). Each attribute was scored based on its intensity scale on a 9-point hedonic scale (1 = disliked extremely, 2 = disliked very much, 3 = disliked moderately, 4 = disliked slightly, 5 = neither liked nor disliked, 6 = liked slightly, 7 = liked moderately, 8 = liked very much, 9 = liked very extremely) for color, flavor, mouth feel and texture.

2.4 Statistical analysis

All the values were expressed as mean ± S.D. The data were statistically analyzed using One-way Analysis of Variance (ANOVA) and the significant differences among the test groups were evaluated by Duncan's Multiple Range Test (DMRT). The results were considered as statistically significant at $P<0.05$. All the statistical analysis were made using SPSS 20.0 (Statistical package for social sciences) software package.

3. RESULTS

3.1 Mushrooms chutney powder

The present study, results dealt with the changes in biochemical composition, microbiological characteristics and sensory properties.

3.2 Changes in the biochemical composition of C. indica chutney powder stored in food grade PET jar at ambient temperature

The changes in the biochemical composition of *C. indica* chutney powder stored in pet jar at ambient temperature are displayed in Table 1. The initial composition of protein, carbohydrate, fiber and ash *C. indica* chutney powder were found to be (51.32 ± 2.88^{a}), (64.14 ± 2.03^{b}), (0.94 ± 0.06^{c}) and (0.77 ± 0.03^{d}) respectively. And it was observed that there was a decline in biochemical composition (30.78 ± 1.33^{a}), (50.32 ± 1.58^{b}), (0.83 ± 0.05^{c}) and (0.62 ± 0.05^{d}) during storage period. The biochemical composition of *C. indica* chutney powder was found to be significantly ($p<0.05$) decreased with the increasing of storage period.

3.3 Changes in the pH, moisture and FFA content of C. indica chutney powder stored in food grade PET jar at ambient temperature

The changes in the pH, moisture and FFA content of *C. indica* chutney powder are shown in Table 2. During storage slight changes were observed in all the quality parameters. The initial values of pH, moisture and FFA content (% oleic acid) were (5.02), (1.72 ± 0.09^{a}) and (0.22 ± 0.01^{b}) respectively. Whereas all the quality parameters values (6.02), (4.83 ± 1.53^{a}) and (0.57 ± 0.02^{b}) were gradually increased at the end of the storage. This increasing observation was statistically significant ($p<0.05$).

3.4. Changes in the Total Plate Count of C. indica chutney powder stored in food grade PET jar at ambient temperature

The microbiological characteristics of *C. indica* chutney powder are shown in Table 3. The Total Plate Count of the *C. indica* chutney powder was observed for *C. indica* chutney powder and it was ranged from (1.3 to 4.2 CFU/g-^{1}).

3.5. Changes in the organoleptic attributes of C. indica chutney powder stored in food grade PET jar at ambient temperature

The organoleptic characteristics of *C.indica* chutney powder are presented in Table 4. The shelf life with respect to sensory quality indicated that the organoleptic characteristic were gradually decreased during storage. The overall acceptability remained with acceptability limit (6.0) at the end of storage period.

4 DISCUSSION

The present research revealed that there was a significant ($p<0.05$) decrease in protein content of the products during storage. This could be caused by anti- nutrients in the substituted in the products as the anti-nutrients interact with the protein to form complexes, which increases the degree of crosslinking, decreasing the solubility of protein and making protein complexes less impressionable to proteolytic attracts, thereby adversely affecting the protein digestibility [13]. At 0 the products developed from *C. indica* recorded highest protein content. However after six months of storage period the protein content was gradually decreased in the products stored in pet jars.

In the present study, the carbohydrate content of the products developed from *C. indica* stored in pet jars showed a significant decrease ($p<0.05$) during storage. This could be due to the high content of trypsin inhibitors and other anti-nutrients in mushroom powders [14]. Trypsin inhibitor is liable for inhibiting the activity of proteolytic enzymes, whereas phytic acid and polyphenols are known to associate with protein to form insoluble complexes, this affecting the *in vitro* digestibility of Total Nonstructural Carbohydrates (TNC) reach a minimum [15]. The nonenzymic browning (Mallard) reactions, which could involve interaction between inherent carbohydrate and the added sugar, resulting in nonreversible formation of compounds causing a decrease in the availability of carbohydrate.

There was a decrease in fiber and ash content of the products and it could be due to the high moisture absorption of natural fiber is one of their deleterious characteristics that can benefit from hybridization, in order to avoid the reduction in mechanical properties of their composites [16]. In the present study, the increased pH during storage for all the products could be due to the low acid foods that have a pH greater than 4.6 and less than 8.0 (Low-acid does not mean low pH, but relates to the pH values above 4.6.). It was noticed that the increase in pH values was more in laminated than the aluminum packaging material.

Table 1. Changes in the biochemical composition of *C. indica* chutney powder stored in food grade PET jar at ambient temperature

Months	Protein	Carbohydrate	Fiber	Ash
0	51.32±2.88 [a]	64.14±2.03 [b]	0.94±0.06 [c]	0.77±0.03 [d]
1	50.02±2.23 [a]	60.83±2.53 [b]	0.94±0.03 [c]	0.77±0.03 [d]
2	45.12±3.64 [a]	57.18±1.56 [b]	0.90±0.04 [c]	0.69±0.02 [d]
3	40.0±3.75 [a]	56.07±1.78 [b]	0.90±0.04 [c]	0.69±0.04 [d]
4	38.72±2.09 [a]	55.19±1.95 [b]	0.89±0.06 [c]	0.68±0.04 [d]
5	33.41±1.08 [a]	51.34±1.67 [b]	0.88±0.03 [c]	0.68±0.04 [d]
6	30.78±1.33 [a]	50.32±1.58 [b]	0.83±0.05 [c]	0.62±0.05 [d]

Values are mean ± S.D. Values not sharing a common superscript letter [(a, b, c, d)] differ significantly at $p<0.05$ (DMRT).

Table 2. Changes in the pH, moisture and FFA content of *C. indica* chutney powder stored in food grade PET jar at ambient temperature

Months	pH	Moisture (g /100)	Free fatty acid (% oleic acid)
C. indica	**chutney powder stored in food grade PET jar**		
0	5.02	1.72±0.09[a]	0.22±0.01[b]
1	5.02	1.70±0.08[a]	0.26±0.01[b]
2	5.31	2.97±1.04[a]	0.32±0.02[b]
3	5.51	3.23±1.97[a]	0.39±0.01[b]
4	5.93	3.87±1.73[a]	0.40±0.01[b]
5	5.99	4.15±1.22[a]	0.44±0.02[b]
6	6.02	4.83±1.53[a]	0.57±0.02[b]

Values are mean ± S.D. Values not sharing a common superscript letter [(a, b)] differ significantly at $p<0.05$ (DMRT).

Table 3. Changes in the Total Plate Count of *C. indica* chutney powder stored in food grade PET jar at ambient temperature

Months	TPC ($x10^3$ CFU/g^{-1})
0	Not Detected
1	Not Detected
2	1.3
3	1.9
4	2.5
5	3.7
6	4.2

Table 4. Changes in the organoleptic attributes of *C. indica* chutney powder stored in food grade PET jar at ambient temperature

Months	Appearance	Color	Taste	Aroma	Over all acceptability
0	8.83±0.53	8.76±0.34	8.53±0.52	8.63±0.75	8.73±0.23
1	8.45±0.61	8.32±0.58	8.27±0.64	8.36±0.62	8.32±0.65
2	8.13±0.38	8.08±0.62	8.03±0.57	8.10±0.59	8.00±0.64
3	7.97±0.54	7.94±0.49	7.88±0.36	7.94±0.34	7.98±0.54
4	7.59±0.49	7.97±0.61	7.70±0.45	7.54±0.46	7.63±0.36
5	7.03±0.65	7.54±0.57	7.23±0.57	7.09±0.64	7.16±0.53
6	6.58±0.41	6.71±0.53	6.63±0.30	6.82±0.43	6.64±0.47

Values are mean ± S.D. No significant difference among organoleptic characteristics of chutney powder (DMRT).

Hedonic scale (9 and 1)

9.	Like extremely	8.	Like Very much	7.	Like moderately
6.	Like slightly	5.	Neither like nor dislike	4.	Dislike slightly
3.	Dislike moderately	2.	Dislike very much	1.	Dislike extremely

The pH is the main indicator of spoilage of any food products. Maintaining of pH is food products retard the spoilage of food by bacteria [17]. Acidity plays a primary role in the preservation of foods and combined with other factors such as heat, water activity, and chemical preservatives acts to prevent food deterioration and spoilage [18].

In the present study, the FFA content (% oleic acid) was very low and gradually increased during storage in chutney powder stored in the pet jars. The lower FFA values in products may due to less lipid content of the products [19]. The gradual increase in FFA results in deterioration of the food products during storage period and this may be the reason for the liberation of FFA in all the products developed from mushrooms [20]. Similar results were reported in control biscuits (wheat) during storage and it was lower than the cereal bran incorporated biscuits. It was reported there was a similar increase in FFA for chutney powder developed from *Lambislambis* [21]. Shanthini [22] reported similar steady increases in FFA content (0.011 to 0.0564 and 0.010 to 0.0537 % oleic acid) in *Pleuroploca trapezium* products stored in packaging materials and pet jar during storage at ambient temperature.

The present microbial quality studies indicated that the mushroom products stored in packaging materials at room temperature for 6 months had better quality and the observed microbial count remained within the permissible limits [23]. This may be due to the physical properties of the packaging material. Also it showed a higher increase in microbial count packaging material. This may be due to increase in storage time and higher moisture content. The author reported that there was a direct relationship between microbial counts and moisture content in oyster gills storage at different temperature [24]. Sensory science is the study, of the reactions of the five senses - sight, hearing, smell, taste and touch to the characteristics of physical matter [25]. Food commodities need to be produced to a level of quality, which will satisfy both the consumer and statutory food legislation. It is therefore the responsibility of the manufacture to develop method, which can evaluate the sensory properties of a food as accurately as possible. All the Hedonic scale (9 and 1) characteristics such as 9 Like extremely, 8 like very much, 7 like moderately, 6 like slightly, 5 neither like nor dislike, 4 dislike slightly, 3 dislike moderately, 2 dislike very much and 1 dislike extremely were showed a decreasing trend in organoleptic scores with duration of storage for all the products. The present study revealed the chutney powder developed from *C. indica* was good and safe for human consumption up to 6 months of storage without any spoilage.

5 CONCLUSION

The sensory scores of chutney powder remained within the acceptable limit throughout the storage period. Food eating habit of the people is changing very fast in recent time, due to improvement in socio-economic condition of the people, availability of new food resources, prepared food etc, for the convenience of the customers. The present study result showed that the products from *C. indica* would help the consumers to make use of protein rich mushroom resources and there by the malnutrition problem particularly among children can be reduced. From the study, it was known that the value addition of chutney powder increased the shelf life of period and it had a good storage life period of 6 months. No spoilage was observed till the end of six month storage. So this processing help to preserve the bioch-emical, nutritional and organoleptic characteristics of new food products. Such products can be utilized by everyone and all the year round. Thus, the present study had proven that these protein rich mushroom products could find a place in the domestic market to increase the utilization of products.

Acknowledgement

The authors would like to express their sincere thanks to Karunya University, Department of Biotechnology for the opportunity to do the research work.

Conflicts of Interest

There are no conflicts of interest.

References

1. Rao, A. V. (2004). Processed tomato products as a source of dietary lycopene: bioavailability and antioxidant properties. *Canadian journal of dietetic practice and research*. 65(4), 161-165.
2. Rao, Q., Fisher, M.C., Guo, M. and Labuza, T.P. (2013). Storage stability of a commercial hen egg yolk powder in dry and intermediate-moisture food matrices. *Journal of Agricultural and Food Chemistry.* 61 (36), 8676-8686.
3. Pamidighantam, R., Galla, N. R., Kripanand, S. M., Karakala, B. and Akula, S. (2013). Preparation and storage stability of flaxseed chutney powder, a functional food adjunct. *Journal of Food Science and Technology*. 50(1), 129-134.
4. Lowry, O. H., Rosebrough, N. J., Farr, A. L. and Randall, R. J. (1951) Protein measurement with the folin phenol reagent. *Journal of Biological Chemistry.* 193, 265-275.
5. Somani, B. L., Khanade, J. and Sinha, R. (1987). A modified Anthrone- Sulfuric Acid method for the determination of Fructose in the presence of certain Proteins. *Analytical Biochemistry.* 167(2), 327-330.
6. 6. Akins, J. R., Waldrep, K. and Bernert, J. T. J. (1989). The estimation of total serum lipids by a completely enzymatic summation method. *Clinica Chimica Acta*. 184(3), 219-226.
7. 7. Lipiec, A., Grela, E., Zurcher, U. and Wenk, C. (1994). Estimation of dietary fiber content of feedstuffs. *Archiv Fur Tierernahrung.* 47(1), 53-62.
8. Cuddeford, D. and Hughes, D. A. (1990). comparison between chromium-mordanted hay and acid-insoluble ash to determine apparent digestibility of a chaffed, molassed hay straw mixture. *Equine Veterinary Journal.* 22(2), 122-125.
9. Association of Official Analytical Chemists (1995) Methods of Analysis for Functional Foods and *Nutraceuticals* AOAC 945, 38, 920 -939.
10. Neill. K. M., Rice. K.T. and Ahern. H.L. (1993). Comparison of two methods of measuring gastric pH. *Heart & Lung.* 22(4), 349-355.
11. Feldsine. P. T., Leung. S. C., Lienau. A. H., Mui. L. A. and Townsend. D. E. Enumeration of total aerobic microorganisms in foods by simplate Total Plate Count-Color Indicator methods and conventional culture methods: collaborative study. *Journal of AOAC International.* 2003; 86(2), 257-274.
12. 12. Menon. L., Majumdar. S.D. and Ravi. U. (2015). Development and analysis of composite flour bread. *International Journal* of *Food Science* & *Technology*. 52(7), 4156-4165.
13. Sirag. H. M. (2009). Biochemical and hematological studies for the protective

effect of Oyster mushroom (*Pleurotus ostreatus*) against glycerol-induced acute renal failure in Rats. *Journal Bioscience Science.* 9, 746-752.

14. Lee. K.W., Kim. Y. J., Kang. N. J., Kim.J. H., Lee. S.J., Kim. D.O., Lee C.Y. and Lee. H.J. (2009). Improved assay for determining the total radical-scavenging capacity of antioxidants and foods. *International Journal* of *Food Sciences* and Nutrition (1), 12-20.
15. Sedaghat. N. and Zahedi. Y. (2012) Application of edible coating and acidic washing for extending the storage life of mushrooms (*Agaricusbisporus*). *Food Science and Technology International.* 18(6), 523-530.
16. Verardo. V., Riciputi. Y., Messia. M. C., Vallicelli. M., Falasca. L., Marconi. E. and Caboni. M. F. (2010) "Dietary fiber and flavan-3-ols in shortbread biscuits enriched with barley flours co-products. *Int. J. Food Sci. Nutr.* . 62, 262-269.
17. Uchoa. A. M., Correia. D. C. J. M., Maia. G. A., Meira. T. R., Sousa. P. H. and Montenegro B. I. (2009). Formulation and physicochemical and sensorial evaluation of biscuit-type cookies supplemented with fruit powders. *Plant Foods for Human Nutrition*. 64(2), 153-159.
18. 18. Mohammadi. M., Abedi. A.S., Azizi. M.H., Ahmadian. F.S. and Pouraram. H. (2011). "Development of fortified biscuit using NaFeEDTA. *Journal of the Science of Food and Agriculture.* 91(11), 1984-1989.
19. Lin. X., Wu. J., Zhu. R., Chen. P., Huang. G., Li. Y., Ye. N., Huang. B., Lai. Y., Zhang. H., Lin. W., Lin. J., Wang. Z., Zhang. H. and Ruan. R. (2012). California almond shelf life: lipid deterioration during storage. *Journal of Food Science.* 77(6), 583-593.
20. Patange. D.D., Patel. A.A., Singh. R.R., Patil. G.R. and Bhosle. D.N. (2013). Storage related changes in ghee-based low-fat spread. *Journal of Food Science and Technology*. 50 (2), 346-352.
21. Nagi. H. P. S., kaur. J., Dar. J. and Sharma. S. (2012). Effect of storage period and packagin g on the shelf life of cereal bran incorporated biscuits. *Asian Journal of science* and *technology.* 7(5), 301 -310.
22. Shanthini. C. F. Value added products from underutilized marine gastropod, *Pleuroploca trapezium* (Mollusca: Gastropoda: Fasciolariidae) Ph.D. Thesis, Manonmaniam Sundarnar University. 2013; 216.
23. Cornu. M., Billoir. E., Bergis. H., Beaufort. A. and Zuliani. V. (2011). Modeling microbial competition in food application to the behavior of *Listeria monocytogenes* and lactic acid flora in pork meat products. Food Microbiology. 28(4), 639-647.
24. Lin. X., Wu. J., Zhu. R., Chen. P., Huang. G., Li. Y., Ye. N., Huang. B., Lai. Y., Zhang. H., Lin. W., Lin. J., Wang. Z., Zhang. H. and Ruan. R. (2012). California almond shelf life: lipid deterioration during storage. *Journal of Food Science.* 77(6), 583-593.
25. Mildner. S. S., Bajerska. J., Zawirska. W. R. and Gorecka. D. (2013). White grape pomace as a source of dietary fibre and polyphenols and its effect on physical and nutraceutical characteristics of wheat biscuits. *Journal of Food Science.* 93(2), 389-395.