International Journal of Biological, Life and Agricultural Sciences
ISSN: 2415-6612
Vol:9, No:6, 2015

Preservation of Coconut Toddy Sediments as a Leavening Agent for Bakery Products

B. R. Madushan, S. B. Navaratne, I. Wickramasinghe

***Abstract*—**Toddy sediment (TS) was cultured in a PDA medium to determine initial yeast load, and also it was undergone sun, shade, solar, dehumidified cold air (DCA) and hot air oven (at 40^0, 50^0 and 60^oC) drying with a view to preserve viability of yeast. Thereafter, this study was conducted according to two factor factorial design in order to determine best preservation method. Therein the dried TS from the best drying method was taken and divided into two portions. One portion was mixed with 3: 7 ratio of TS: rice flour and the mixture was divided in to two again. While one portion was kept under in house condition the other was in a refrigerator. Same procedure was followed to the rest portion of TS too but it was at the same ratio of corn flour. All treatments were vacuum packed in triple laminate pouches and the best preservation method was determined in terms of leavening index (LI). The TS obtained from the best preservation method was used to make foods (bread and hopper) and organoleptic properties of it were evaluated against same of ordinary foods using sensory panel with a five point hedonic scale.

Results revealed that yeast load or fresh TS was 58×10^6 CFU/g. The best drying method in preserving viability of yeast was DCA because LI of this treatment (96%) is higher than that of other three treatments. Organoleptic properties of foods prepared from best preservation method are as same as ordinary foods according to Duo trio test.

***Keywords*—**Biological leavening agent, coconut toddy, fermentation, yeast.

I. Introduction

TODDY is a common in various parts of Asia and Africa and goes by various names, such as *Emu* in Nigeria, *Nsamba* in the Congo and *Raa* in Sri Lanka. Toddy is collected as a sap by the tapping of the coconut inflorescence at immature stage [1]. The collected sap will be undergone 8 hours for fermentation into toddy and thereafter it was syphon out from the vat and the sediment is left out as a waste material. Even though the sediment is thrown out as an un-economical product it may contain plenty of vegetative yeast cells and spores.

There are several types of leavening agent available in the market namely biological leavening agents (yeast), chemical leavening agents (bicarbonates). Since, toddy sediment contains plenty of yeast cells and spores it can be used as a biological leavening agents. In biological leavening agents category there are several types for bakery industry available in the market namely cream yeast compressed yeast, active dry yeast and high acidity dry yeast [2], Commercially yeast (*Saccharomyces cerevisiae*) is mainly produced on grain mashes or sucrose rich molasses [3].Yeasts have been used by people since old ages (4000 to 5000 years ago) and nowadays it is being using in vast applications mainly in bakery industry. Consumption of bakery products has been dramatically increased in past years also. Yeast could be aerobic or facultative anaerobic and its carbohydrates, lipids and nitrogen metabolism activities are very helpful for the bakery industry.

Since Sri Lanka is situated in tropical belt of the globe the different types of air born yeast strains are available. Sri Lankan scientists have also reported that there were different types of yeasts and yeast strains available in coconut toddy [4]. Some of these strains are responsible for sugar fermentation. And sediment after fermenting is highly perishable, which (fresh sediment) is used by rural folks for domestic scale food preparation. It has been reported that palmyrah toddy mixed culture has performed better than the baker's yeast [5]. Since coconut toddy sediment is a wasteful by product and possibly good source of yeast spores, scope of this study is to identify yeast load in the sediment, preservation technique and possible utilization of it in food industry.

B. R. Madushan is with the Department of Food Science & Technology, University of Sri Jayewardenepura, Gangodawila, Sri Lanka (corresponding author to provide phone: +94 779-250-280; e-mail: as65568@sci.sjp.ac.lk).

S. B. Navaratne and I. Wickramasinghe are with the Department of Food Science & Technology University of Sri Jayewardenepura, Gangodawila, Sri Lanka (e-mail: sbnava1234@gmail.com, indiraw2002@yahoo.com).

II. Methodology

A. Collecting Samples

Toddy sediment samples were collected from a large scale coconut tavern in the down south area in Sri Lanka, were put to a sterile container and turned the lid lightly. Then the container was placed in an ice crystal bath for reducing microbial activities and their growth. Thereafter, collected samples were transported to the laboratory and kept under refrigeration condition for the subsequent areas of the study.

B. Determination of Yeast and Mold Count Using Pour Plate Method

Dilution series of fresh toddy sediment and the toddy sediment of the best drying method were prepared up to 10^{-6} dilution using 1g of toddy sediment. Then potato dextrose agar was used for culture yeast and molds. Acidity of the medium was set to approximately 3.5 pH with sterile tartaric acid achieves the inhibition of bacterial growth. Thereafter 1ml of the toddy sediment of each dilution is fed in to each dish and then a thin layer of media is poured. Then dishes were incubated at the room temperature (29^oC) for 48 hours and yeast CFU (colony forming units) of fresh toddy sediment and toddy sediments of the best dying method were recorded according to [6]. Finally average CFU/g count was taken.

C. Determination of Leavening Index (LI)

Twenty five grams of wheat flour and 2g of sugar were mixed with 5g of toddy sediment while incorporating adequate amount of water until dough was converted in to suitable consistency. Thereafter a portion of the dough was taken and put in to a measuring cylinder up to 25ml level and it was kept under in-house condition (RH 78% and 29^{0}C).

A layer of paraffin oil was poured onto the top of dough in the measuring cylinder to prevent exposing the dough to the normal atmosphere. Thereafter increased volume of dough was recorded after two and half hours in in-house condition. And leavening index was calculated using

$$\text{LI} = \frac{\text{Increment of dough volume}}{\text{Initial dough volume}} \times 100 \quad (1)$$

D. Determination of the Best Drying Method

Seven different types of drying methods namely sun drying, shade drying, solar drying, cold dehumidified air drying and hot air oven drying were used to dehydrate the toddy sediment until the moisture content reach to the safe level (6-8%).

In hot air dying at 40^{o}C, 50^{o}C and 60^{o}C temperatures, sensible heating at constant humidity ratio drying process was used. Therein normal atmospheric air was conditioned to get above three temperatures and conditioned air was blown over the wet toddy sediment until it attain to the safe moisture content. In cold dehumidified air dying process, normal atmospheric air was conditioned to get 8^{0}C and RH 10% (approximately) and this cold dry air was used to dehydrate the toddy sediment. In sun drying (at 40^o-45^{o}C) the toddy sediment was under protective cubicle and drying was carried out until moisture content reach to the safe level. In the case of shade drying (at 28-30^{o}C), it was done using a specially designed chamber in the laboratory with aeration facility. Solar drying was done using a fabricated prototype solar drier. The normal atmospheric air was blown to the collector (28-30^{0}C) in order to make the cold air hot (70-75^{0}C). The speed of the blowing fan was used to control the 28-30^{0}C temperature of the blowing air. The hot air generated from the collector was blown over the wet toddy sediment until toddy sediment attain safe moister content. The best drying method was determined in terms of the leavening indexes by comparing values.

E. Determination of the Best Preservation Method

This experiment was conducted according to two factor factorial experimented design. Therein toddy sediments of best drying method was taken and divided into two portions and one portion was mixed with rice flour at the ratio of 3: 7 (toddy sediment: rice flour) and this portion was again divided to two equal portions. While one portion was kept under refrigerator condition and the rest was kept in in-house condition. Same procedure was followed to rest portion but with corn flour. (3: 7; toddy sediment: corn flour)

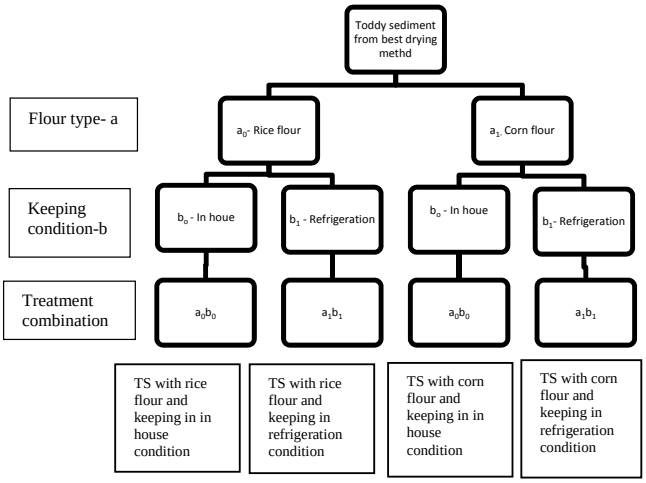

Fig. 1 Design of the experiment

All the treatments were triplicated and vacuum packed using triple laminated pouches. Samples were drawn from each treatment weekly and leavening index was measured in order to determine the best preservation method. The design of the experiment is shown in Fig. 1.

F. Evaluation of Organoleptic Properties of Food Products

The dried toddy sediment of the best preservation method was taken and two leaven food products (bread and hopper) were made.

Breads were made with a standard bread recipe (without using yeast) according to the prescribed method [7]. Organoleptic properties of prepared breads such as color, crispiness, flavor, odor, texture and overall acceptability were compared against same of ordinary breads according to Duo-trio test method using 30 respondents. The sensory profiles of both treatments with respect to six sensory stimuli were drawn using 5 point hedonic scale along with same number of respondents (30).

Hoppers also were made with a standard bread recipe (without using yeast) according to the prescribed method. Organoleptic properties of prepared hoppers such as crispiness, taste, odor, texture of the edge of the hopper and taste, texture odor color of middle of the hopper and overall acceptability were compared against same of ordinary hoppers according to Duo-trio test method using 30 respondents too. The sensory profiles of both treatments with respect to ten sensory stimuli were drawn using 5 point hedonic scale along with same number of respondents (30).

III. Results and Discussion

Initial pH, moisture content, solid content, AND LI of toddy sediment were measured, which were 3.6, 87.05% 12.95% and 120% respectively. Therefore fresh toddy sediments was somewhat acidic watery. And also it contains live yeast cells and spores as it has shown a strong value for the leavening index.

A. Determination of Yeast and Mold Count

Yeast plate count of fresh toddy sediments and toddy sediments of best drying method were 58×10^6 and 51×10^6 CFU/g. Therefore this count is also indicate presence of live yeast cells and spores in fresh toddy sediments and toddy sediments out of best drying method as well.

B. Determination of the Best Drying Method in Terms of LI

Leavening index of dried toddy sediments obtained from drying methods namely sun drying (40-45°C), shade drying (28-30°C), solar drying (70-75°C), cold dehumidified air drying (8°C) and hot air oven drying (40°C, 50°C and 60°C) are given in Table I.

TABLE I
LEAVENING INDEX OF DRYING METHODS

Drying method	Mean LI % $\bar{x}$	Mean variation $\bar{x}$ ± SD
Sun drying (40-45°C)	0	0
Solar drying (70-75°C)	0	0
Shade drying (28-30°C)	75.33	4.1
Oven drying		
40°C	34.66	3.77
50°C	0	0
60°C	0	0
Cold dehumidified air drying (8oC)	114.05	1.95

The data given in Table I indicate that the best dying method is cold dehumidified air drying at 8°C because this treatment was capable to preserve viability of yeast cells more than the other 6 drying methods. Because LI is more due to presence of more live yeast cells and spores.

C. Determination of the Best Method for Preservation of Dried Toddy Sediment

The best preservation method pertaining to the two factor factorial design was measured in terms of LI weekly for period of 4 weeks and results are given in Table II.

TABLE II
LEAVENING INDEX OF TREATMENTS WITH RESPECT TO STORED TIME PERIOD

Mean leavening index %($\bar{x}$) & mean variation(± SD)		Treatment $a_0 b_0$	$a_1 b_0$	$a_0 b_1$	$a_1 b_1$
After 1st week	Mean LI	101.33	105.33	108	112
	Mean variation	1.88	1.88	0	1.88
After 2nd week	Mean LI	92	90.66	101.33	105.33
	Mean variation	0	1.88	1.88	1.88
After 3rd week	Mean LI	84	96	93.33	101.33
	Mean variation	3.26	3.26	1.88	1.88
After 4th week	Mean LI	79.33	88	89.33	96
	Mean variation	5.73	3.26	1.88	1.88

The data given in Table II clearly indicate that the best preservation method of toddy sediment is a_1b_1 (Mixing with corn flour and keeping with refrigerator condition). Reason for this consequence is viability of yeast spores preserved under low temperature storing (8°C). Therefore storing in refrigeration condition is a productive option in preserving of yeast cells in toddy sediments. Moreover, as corn flour is somewhat inert it doesn't have any influence on the viability of yeast cells up to four weeks of period of storage. This conclusion is further evidenced by the mean variation of the best treatment which is 96 ± 1.88 %.

D. Evaluation of Organoleptic Properties of Bread

Organoleptic properties such as color, flavor, odor, texture and overall acceptability of bread prepared form the best preservation method of toddy sediment were compared with the same of ordinary bread. Since both treatments were failed to secure minimum responses (21) to get a significant difference, there is no significant difference between ordinary bread and bread prepared with toddy sediments. To further elaborate this outcome, sensory profiles for the both treatments were drawn which is given in Fig. 2.

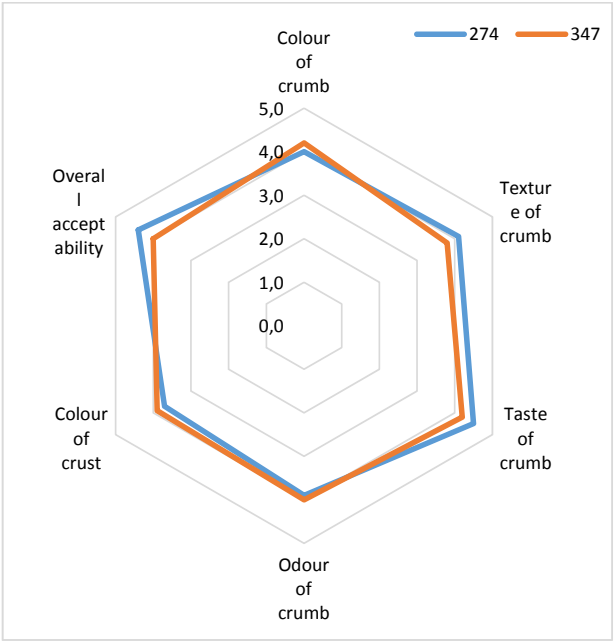

Fig. 2 Sensory evaluation of breads

Sensory profiles also clearly indicated that there was not significance difference between sensory stimuli of both products.

Organoleptic properties such as crispiness, taste, odor, texture of the edge of the hopper and taste, texture odor color of middle of the hopper and overall acceptability of bread prepared form the best preservation method of toddy sediment were compared with the same of ordinary hopper. Since both treatments were failed to secure minimum responses (21) to get a significant difference, there is no significant difference between ordinary bread and bread prepared with toddy sediments. To further elaborate this outcome, sensory profiles for the both treatments were drawn which is given in Fig. 3

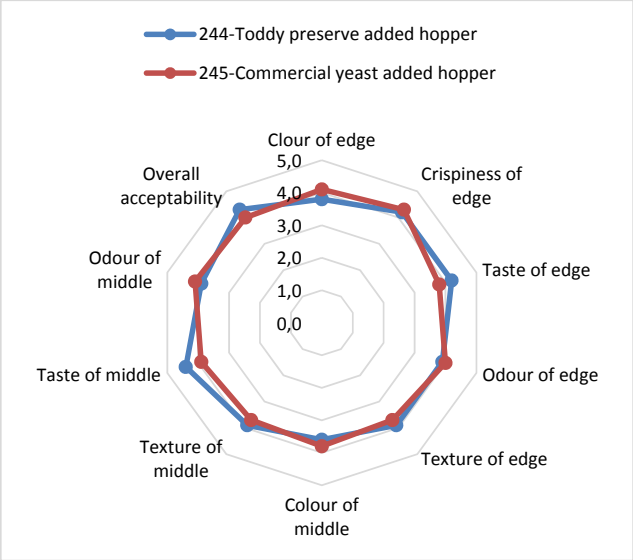

Fig. 3 Sensory evaluation of hoppers

IV. Conclusion

The best drying method in preserving of toddy sediments was cold dehumidified air dying at 8°C.The best treatment in preserving of toddy sediment is incorporating of corn flour at the ratio of 7:3 and keeping the mixture under refrigeration condition. Bread prepared form the best treatment is as almost same as normal bread in term of sensory stimuli as well as sensory profiles. Therefore toddy sediment is a best source for leavening food products and it can be served in dry form for at least four weeks period.

Acknowledgement

The authors gratefully acknowledge the assistance of the toddy tavern owner and the staff of Payagala, Sri Lanka for supplying toddy sediment and laboratory staff of the Department of Food Science & Technology, University of Sri Jayewardenepura, Sri Lanka.

References

[1] Leong, P. (1953). The Nutritive Value of Coconut Toddy. BJN, 7(03), p.253.
[2] McWilliams, Charles S, and Martin S Peterson. Yeast: Its Characteristics, Growth, and Function in Baked Products. Washington: Advisory Board on Quartermaster Research and Development, Committee on Foods. Subcommittee on Cereal and Baked Products, National Academy of Sciences-national Research Council, 1957. Print.
[3] Simpson, Benjamin K. Food Biochemistry and Food Processing. 2nd ed. Ames, Iowa: Wiley-Blackwell, 2012. Print.
[4] Chandrasena, G., Keerthipala, A. and Walker, G. (2006). Isolation and Characterisation of Sri Lankan Yeast Germplasm and Its Evaluation for Alcohol Production. Journal of the Institute of Brewing, 112(4), pp.302-307.
[5] Balakumar, S. and Arasaratnam, V. (2009). Comparison of Industrial Scale Ethanol Production from a Palmyrah-Based Carbon Source by Commercial Yeast and a Mixed Culture from Palmyrah Toddy. Journal of the Institute of Brewing, 115(2), pp.105-110.
[6] Food Microbiological Examination: Enumeration of Yeasts and Molds. Ministry of Health of P. R. China, 2012. Print.
[7] AACC (2000), Approved Methods of the American Association of Cereal Chemist, The American Association of Cereal Chemists, Inc., St Paul, MN.