

REHYDRATION CHARACTERISTICS OF MUSHROOMS USING DIFFERENT DRYING TECHNIQUES

ABSTRACT

Mushroom may be baked, fried, boiled, creamed, roasted, pickled and stuffed. In India, it is mostly consumed fresh and a negligible amount is used for processing. They can be processed as canned, dried and frozen mushrooms. The dried mushrooms are packed in hermetically sealed air tight tins for quality retention and stored at a cool dry place. The main objective of the study is to know the effect of different drying methods on the quality of mushrooms and its dehydration, rehydration characteristics. Sun drying and Cabinet tray drying methods were selected in the study. Rehydration ratio and coefficient of rehydration were calculated and compared for both the drying methods. Organoleptic evaluation was done by an expert committee. The results showed that cabinet tray dried mushrooms were reconstituted well compared to the sundried ones. The values of coefficient of rehydration and rehydration ratio for cabinet dried mushrooms were found as 0.498 and 1:3.3 which were higher than sundried mushrooms. Cabinet tray dried mushrooms showed it's superiority in organoleptic evaluation. From the study it was concluded that mushrooms dehydrated by the cabinet tray drying have better rehydration characteristics than sun drying.

Comment [NM1]: Better?

Comment [NM2]: Consider to use other terminology, such as, sensory assessment, to avoid repeating the same words

Introduction

Mushroom is an edible fungus that is used as food since ancient times. It grows on decomposed organic matter and edible part grows above the surface of the substrate. Mushrooms grow in the dark and propagate by releasing spores. Mushrooms are grown all over the world and have been considered honour food in many cultures (Chang and Buswell 1993). These are not only used for consumption but also used for medicinal purposes (Bobek *et al.*, 1997; Chocksaisawasdee *et al.*, 2010; Yang *et al.*, 2001). Out of large varieties of mushrooms, less than 25 species are accepted as food and some of them have assumed commercial significance (Angle and Tamhane, 1974).

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Drying is a mass transfer process consisting of the removal of water. Drying process is used in mushrooms to remove the moisture content and to increase the shelf life. Mushrooms are extremely perishable and several physiological and morphological changes occur after harvest, which make these mushrooms unacceptable for consumption. Due to

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drying process the consumption of mushrooms is easy and acceptable. The advantage is that almost all kinds of mushrooms can be conserved by drying. Rehydration is the process of restoring lost water (dehydration) to the body tissues and fluids. Prompt rehydration is imperative whenever dehydration occurs, from diarrheal, exposure lack of drinking water, or medication use. The dehydrated mushrooms can be rehydrated by water immersion before consumption. The rehydration characteristics of dried products are taken as indication for physical and chemical changes occurred during the drying process (Lewicki, 1998).

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Experiments conducted in many countries have clearly shown that drying of mushrooms can increase the essential properties for the beneficial use. Keeping in view all the aspects, a study is planned to assess different drying methods with regards to product quality obtained and to analyze the drying and rehydration characteristics of mushrooms using different drying methods.

Material and Methods:

In this section description of entire procedure followed in this study, complete knowledge of different drying methods and calculation procedure of dehydration and rehydration of fruits were given.

The fresh mushrooms were purchased from local market. Post-harvest operations such as grading, washing and cleaning was done to remove the hard soil particles adhering to them. Blanching was done to kill the microbial activity of mushrooms. Sun drying and Cabinet tray drying methods were selected for this study. Coefficient of rehydration and rehydration ratio were calculated for both drying methods.

Comment [NM3]: Species? Scientific name? Total amount and quantity used for each step of the study?

Comment [NM4]: Time and temperature? Medium of blanching?

Comment [NM5]: Please explain in detail the sun drying and cabinet tray drying methods (how they were conducted?)

Rehydration ratio can be calculated by the following formula.

$$\text{Rehydration ratio} = \frac{\text{Weight of rehydrated Sample}}{\text{Weight of dehydrated Sample}}$$

Rehydration coefficient is one of the important parameters in rehydration characteristics of fruits and vegetables. Rehydration coefficient can be calculated by the following formula.

$$\text{Coefficient of Rehydration} = \frac{W_r}{\frac{W_d - W_u \times 100}{100 - A}}$$

Comment [NM6]: Please explain the notation and their units of measurement

The organoleptic quality can be tested using hedonic scale 1-9 (scale: 1-9; 1- most disliked and 9- most liked). The format of the evaluation report is given in below table. Organoleptic evaluation of dried mushrooms was performed by a panel of 2 semi trained judges of Vikas College of Engineering and Technology, Nunna, Vijayawada, India.

Comment [NM7]: hedonic

Comment [NM8]: consider to remove

Comment [NM9]: what does that mean?

Like Extremely-9, Like verymuch-8, Like Moderately-7, Like Slightly-6, Neither like or Dislike-5, Dislike slightly-4, Dislike Moderately-3, Dislike Very much-2, Dislike Extremely-1

Sample code	Taste	Smell	Appearance	Texture
1				
2				



Results and Discussion:

The section deals with the results of experimental observation that have been carried out, analyzed and discussed in relation to the mushroom dried by different drying methods. The fresh mushrooms were purchased from local market. Post-harvest operations such as grading, washing, cleaning was done to remove hard soil particles adhering to them. Blanching was done to kill the microbial activity of the mushrooms.

Dehydration of mushrooms takes place in both open sun and cabinet tray dryer. Measurement of weights was taken in fixed interval of time. The decrease in the moisture content was calculated at each step. Dehydrated mushrooms can be rehydrated by procedure mentioned earlier. Rehydration ratio and coefficient of rehydration was also calculated for mushrooms dried using both the drying methods according to the formulas given in earlier section. Drying of mushrooms using open sun and cabinet tray dryer was shown in fig 1.

Comment [NM10]: -Rehydration procedure should be explained.

-Sampling for sensory analysis and rehydration test should be justified.

-Method for moisture content measurements?

-Data collection and analysis methods need to be provided

Comment [NM11]: repeated information as above, pls. consider to remove

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Fig. 1. Drying of Mushrooms using Open sun and Cabinet Tray Dryer

To evaluate the organoleptic characteristics of mushrooms dried by sun drying and cabinet tray dryer, an expert committee was formed having Er. K. Pawan, Assistant Professor, Agriculture Engineering Department and Er. G.Raju, Assistant Professor, Agriculture Engineering Department, Vikas college of Engineering and Technology, Nunna. The results obtained from the rehydration characteristics and organoleptic characteristics were given in Table 1. It is clear from the Table 4.1 that Cabinet Tray dried mushrooms registered highest rehydration ratio of 1:3.3 where Sun dried mushrooms exhibit lower rehydration ratio of 1:2.9. Highest coefficient of rehydration value was also obtained for the cabinet tray dried mushrooms having the value of 0.498. The coefficient of rehydration of sun-dried mushrooms is lower than that of cabinet tray dried ones having the value of 0.466. Cabinet Tray dried mushrooms are reconstituted well and its moisture content value is somewhere closer to the fresh mushrooms when compared to the sun-dried mushrooms.

Table 1. Quality parameters of rehydrated button mushroom dried by different methods

Drying Method	Moisture Content (% wet basis)			Co-efficient of Rehydration	Rehydration Ratio	Organoleptic Quality
	Fresh	Dehydrated	Rehydrated			
Sun drying	89.8	10.2	78.1	0.466	1:2.9	Satisfactory
Cabinet Tray drying	89.8	10.0	79.5	0.498	1:3.3	Good

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Comment [NM12]: Misplacing: The highlighted paragraphs and Fig. 1 are not the results but the methods.

Comment [NM13]: higher?

Comment [NM14]: higher?

Comment [NM15]: Remove these words as they are providing the same meaning/information as the previous sentence

Comment [NM16]: Data should be displayed as means +/- standard deviation and significant differences

Comment [NM17]: Results of hedonic rating (9-point scale) should be placed here, not the description!

It is advisable to have a table of organoleptic results by attributes (taste, smell, appearance, texture) x samples of the 2 drying methods (table 2?)

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The organoleptic evaluation of rehydrated product showed that the texture, colour and flavour of the rehydrated samples of cabinet tray dried mushrooms were very good and was followed by sun dried mushrooms. The texture and colour of the rehydrated samples of the sun-dried mushrooms were rated only satisfactory as the parameters seems to have been adversely affected by the drying method.

The present study indicates that the mushrooms dehydrated by the cabinet tray drying have better rehydration characteristics than sun drying.



Conclusions:

Mushrooms dried using different drying methods can be evaluated for their quality, dehydration, rehydration and organoleptic characteristics.

From the above study the following conclusions can be drawn:

1. Cabinet tray drying took minimum effective time for drying mushrooms than sun drying.
2. The samples deteriorated by the insects and rodents in open sun drying. The drying rate was also very slow and final moisture content was above the recommended limit, so the open sun drying method was not suitable.
3. Sun dried mushrooms exhibit lower rehydration ratio than the cabinet tray dried mushrooms.
4. Cabinet Tray dried mushrooms are reconstituted well and its moisture content value is somewhere closer to the fresh mushrooms when compared to the sun- dried mushrooms.
5. The organoleptic evaluation of rehydrated product showed that the texture, colour and flavour of the rehydrated samples of cabinet tray dried mushrooms were very good and was followed by sun dried mushrooms.
6. The present study indicates that the mushrooms dehydrated by the cabinet tray drying have better rehydration characteristics than sun drying.

References:

- Angle, R. Y. and Tamhane, D. V. 1974.** Mushrooms: An exotic source of nutritious and palatable food. *Indian Food Packer* 28(5): 22.
- Bobek, P., Ozdín, L. and Kuniak, L. 1997.** Effect of Oyster mushroom and isolated [beta]- glucan on lipid peroxidation and on the activities of antioxidative enzymes in rats fed the cholesterol diet. *J. Nutritional Biochem.* 8: 469-71.

Comment [NM18]: -Results need to be in more detail.
-Compare the results with the findings of other/previous similar studies

Comment [NM19]: No results were shown in the results and discussion part!

Comment [NM20]: No results were shown in the results and discussion part!

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Comment [NM21]: Consider to use lower case in a consistent way in the whole manuscript

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Chang, S. T., Buswell, J. A. and Miles, P. G. 1993. *Genetics and Breeding of Edible Mushrooms*. Pp. 305. Gordon and Breach, New York.

Chock chaisawasdee, S., Namjaidee, S., Pochana, S. and Stathopoulos, C. E. 2010. Development of fermented Oyster-mushroom sausage. *Asian Journal of Food and Agro- Industry* 3: 35-43.

Lewicki, P. P. 1998. Some Remarks on Rehydration of Dried Foods. *J. Food Eng.* 36: 81-87.

Yang, J. H., Lin, H. C. and Mau, J. L. 2001. Non-volatile taste components of several commercial mushrooms. *Food Chemistry*. 72: 465-71.

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