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Original Research Article

Improving Food Security with Better Quality of Dried Oyster Mushroom (*Pleurotus spp.*)

Anita Kumari[1*] and Maya Kumari[2]

[1]S.M.S. (H.Sc.), K.V.K., Khagaria, Bihar, India
[2](H.Sc), K.V.K., Sahibganj, Jharkhand, India
**Corresponding author*

A B S T R A C T

Postharvest loss remains one of the major causes of food insecurity in developing countries such as India. While mushroom is consumed by many Indian households, fresh harvested mushrooms have very limited storage life. Drying these mushroom confer a stabilizing property to it and then can be stored for a longer period. Effect of pretreatment on the quality of dried oyster mushroom was studied for various chemical pretreatments viz. 1.0% potassium metabisulphite, 0.5% citric acid and 0.5% Potassium metabisulphite + 0.2% citric acid, and control viz. Oven drying and Sun drying. It was observed that application of 1% potassium metabisulphite treatment prior to drying using Oven dryer, gave best quality dried mushrooms with results in accordance with the drying time, final moisture content and sensory quality than the Sun Dried Mushroom. Color is a quality attribute, which together with aroma, taste and texture play an important role in consumer acceptability. It is recommended that fresh mushroom is preserved by Oven dryer prior to drying using preservatives to avoid food spoilage and ensure food security at the household level.

Keywords

Food security, oyster mushroom, pretreatments, oven drying, sun drying and sensory evaluation

Introduction

Food insecurity remains one of the world's major problems. According to the Food and Agricultural Organization, approximately 795 people million are undernourished across the globe. The period of inadequate household food provision is the time between stock depletion and the next harvest (Bilinsky and Swindale, 2007). The major cause of food insecurity in India and many developing countries is attributable to the greater percentage of post-harvest losses. The need for research on small-scale preservation of highly perishable foods to prevent wastage is timely. Food security exists when all people at all times have physical and economic access to adequate, safe, acceptable and nutritious food to meet their daily requirements (FAO, 2014 & 1996). Post-harvest preservation makes local staple foods available and affordable even during off-seasons. Small-scale food preservation practices can ensure the presence of divers nutrients, vitamins and minerals in daily diets and during lean seasons. In India, oyster mushrooms are well-known and consumed in many households.

Oyster mushroom (*pleurotus spp*) belonging to class Basidiomycetes and Family Agaricaceae is properly known as 'dhingri' in India Mushroom is also called white

vegetables or "boneless vegetarian meat". They fall between the best vegetable and animal protein sources (manjunathan *et al.,* 2011). Production and consumption of oyster mushroom have registered tremendous increase in the recent past (Singh *et al.,* 2008). Mushrooms are liked for their delicious flavor, low calorific value and high protein contents, vitamins of B-group and minerals. Mushroom contains 20–40% proteins on a dry weight basis and no cholesterol, and is almost fat free (Walde *et al.,* 2006).Mushrooms are a good source of non-starchy carbohydrates, dietary fiber, protein, mineral and vitamins (Kulshreshtha *et al.,* 2009). Shelf-life of mushrooms is limited to a few days under normal refrigeration conditions, which is a constraint on the distribution and marketing of fresh product, making extension of mushroom's shelf life a constant quest (Akbarirad, *et al.,* 2013). After harvesting, moisture loss, shrinkage and rapid spoilage in terms of color and texture takes place. There are many methods for preservation and enhancement of shelf life of mushrooms. The most common processes include canning, freezing and drying. Although canning is widely used on a commercial scale, it is quite expensive (Kulshreshtha *et al.,* 2009). It is reported that drying is a comparatively cheap method (Rama & Jacob John 2000) and dried mushrooms, packed in airtight containers can have a shelf life of above one year (Bano *et al.,* 1992).Drying is one of the important preservation techniques performed for storage of mushrooms and dehydrated mushrooms are valuable ingredients in a variety of food formulations such as instant soups, sauces, snacks, pizzas, and meat and rice dishes. Conventional air drying is one of the most frequently used techniques for mushroom dehydration, which involves thermal and /or chemical pretreatment and drying at temperature maintained between 50 and 70^0C. Due to long drying time and overheating of surface during sun drying, the problems of darkening in colour, loss in flavour and decrease in rehydration ability occur. Pretreatments of mushrooms before drying in one form or other viz, Blanching, potassium metabisulphite (KMS), Citric acid and salt solution, either alone or in combination help in checking enzymatic browning, stabilizing colour, enhancing flavour retention and maintaining textural properties (Singh *et al.,* 2001). Solutions with potassium metabisulfite and/or citric acid prior to drying are frequently used for mushrooms to prevent enzymatic or non-enzymatic browning (Argyropoulos *et al.,* 2008). The quality of dried mushrooms is determined by combination of factors, but most properties or characteristics depend on consumer preference. Colour and texture of the product are of prime importance to the consumer as product quality criteria which are affected by physicochemical treatments to mushrooms. Heat treatment like drying has been reported to affect colour and texture of various products. However, pre-drying treatments viz. blanching and sulphitation also affect the quality of dried products (Kotwaliwale *et al.,* 2007). The blanching temperatures commonly used in industry (90- 100^oC) may lead to undesirable tissue softening (Ahrne *et al.,* 2003) while sulphitation causes colour retention. Colour changes during drying are mostly in the form of browning caused by enzymatic or non-enzymatic reactions between carbohydrate and amino acids at elevated temperature (Kotwaliwale *et al.,* 2007). Furthermore, the rehydration ability of the dried product is considered to be a critical parameter indicating the degree of the damage to the material caused by physicochemical treatments (Krokida & Marinos-Kouris 2003). The present study was conducted to generate information on

dehydration characteristics and effect of drying temperature and pre-drying treatments on colour and rehydration ratio of dried oyster mushroom. The objective of this paper was to investigate the effects of pre-treatment and drying on the keeping and sensory qualities of dried oyster mushroom.

Materials and Methods

Oyster mushroom (*pleurotus spp.)* was purchased from the KVK farm for study. After sorting and cutting stalk with the help of stainless steel knife the mushrooms (fruiting body) were washed thoroughly in fresh water and dried in air under normal room temperature to remove extra water on the surface. Then they were weighed and cut into 3-4 cm long pieces, each having, stalk up to 2-4 cm in length. The mushroom fruiting body were divided into four equal parts; the first part serves as the control and did not undergo any treatment while each of the other three parts were blanched in open pan containing hot water (98 $+1^0$C) for 3-4 min as a pretreatment (Thakur and Thakur 2000). The ratio of material to water was 1:10. It was reported (Srivastava and Sulebel 1975) that the hot water blanching resulted in better colour and flavour than steam blanching. After completion of blanching the material was removed quickly and subjected to one of the following treatments viz. (T1:1.0% potassium metabisulphite solution, T2:0.5% citric acid solution and T3:0.5% potassium metabisulphite + 0.2% citric acid solution) for 15 minutes. After that the treated mushrooms spread over a perforated tray to drain excess water. An amount of one pretreated mushrooms was taken as one unit. A total at six units were taken for the study. All the six units containing 1 kg pretreated mushrooms were kept in three steel trays for Oven drying and three unit kept on black polythene sheet for Sun drying separately.

Oyster mushroom drying

Sun drying

The blanched mushrooms of three units was dried by direct exposure to sunlight at temperature 30-35^{0}C after covering then with muslin cloth in the open yard.

Oven drying

Rest three units were kept in the oven for drying at 50-60^{0}C. The dryer was adjusted to the selected temperature and was switched on for at least 30 min. before start of experiment to bring the dryer in a steady state. The dried sample was collected from the tray and cooled to room temperature. Dehydrated samples from both the processes were weighed and sealed in polythene bags, after that it kept in airtight plastic containers for 0-6 months. After dried mushrooms kept in ambient conditions for subsequent evaluation of rehydration test and sensory qualities.

Analytical methods

The dehydrated mushrooms were analyzed for proximate composition such as moisture, ash, fat, crude fiber, crude protein and carbohydrate content by the method of National Institute of Nutrition, Hyderabad. The moisture content was determined by Hot Air Oven methods of AOAC. The data collected from the oven drying and sun drying was used to calculate final moisture content (FMC) [% db], drying temperature (DT) [0C], and rehydration ratio (RR). The moisture content before or after the drying was calculated by standard oven method (AOAC, 2000). The rehydration characteristics were calculated as per Ranganna (1986). The data observed from various experiments was analyzed in terms of effect of different methods and

pretreatments on the quality of dried mushrooms.

Rehydration characteristics

Rehydration test was performed in both the samples i.e. Pretreated Sun dried and Oven dried sample by the procedure as described below. Dried mushroom weight 10g was placed in 500ml of beaker containing 150ml of boiled distilled water for 5min. on electric heater and then removed the material. The same procedure was repeated for 20-30 minutes. Excessive amount of water was removed by suction on Buchner Funnel till the drip from the funnel has almost stopped. The sample was weight to determine the rehydration ratio (Anon, 1944).

Calculation

$$\text{Rehydration ratio} = \frac{Wr}{Wd}$$

Where,

Wr: Weight of the rehydrated sample
Wd: Weight of dehydrated sample

Sensory evaluation

For sensory evaluation mushroom recipes such as Pakodas, Mix vegetables and Koftas from pretreated Oven dried and Sundried mushroom after 90 days and 180 days of storage were prepared separately. The evaluators consisting of 30 respondents from the village Hardaschowk, Mehsouri and Amani were selected randomly from the Khagaria district.

The Organoleptic qualities like colour, flavor, texture, taste and over all acceptability were determined by using 9points hedonic scale.

Results and Discussion

Proximate composition of dehydrated Mushrooms

The moisture, ash, fat, crud fiber, crude protein and carbohydrate content of fresh, sundried and oven dried mushrooms have been presented in Table No.2. The moisture content was found to be higher in sundried sample (9.58 +0.16%) as compared to oven dried sample (9.03+0.05%) whereas ash content was higher in oven dried sample consisting of 8.40+0.08% and 7.48+0.07 respectively. Fat contents were observed in sun and oven methods of dehydration (1.33+0.25%) (1.69+0.19).

The crude fiber contents were 35.60+0.25 and 37.50+0.4 per cent in sundried and oven dried samples respectively. There was difference in crude protein content of sundried sample compared 20.89+0.20 to oven dried sample 23.84+4.37 where as in fresh mushrooms it was found to be 2.52%. Carbohydrate content was higher in sun dried sample (60.34+0.22) than in oven dried sample (57.41+4.36).

It can be concluded that moisture content of dehydrated mushrooms was below the desired level in both the methods of drying which ensured increased the shelf life of mushrooms. As lower moisture content reduces the volume of vegetable bulk of the vegetables can be stored in small space which also makes its transportation easier. The higher fiber content of oven dried samples can be utilized for the development of therapeutic diets requiring high fiber content. The protein content of oven dried mushrooms was higher than the sundried mushrooms. Hence, dehydrated mushrooms can be utilized for year round supplementation of our diet with essential nutrient rich vegetable.

Fig.1 Acceptability testing of sun dried and oven dried mushrooms

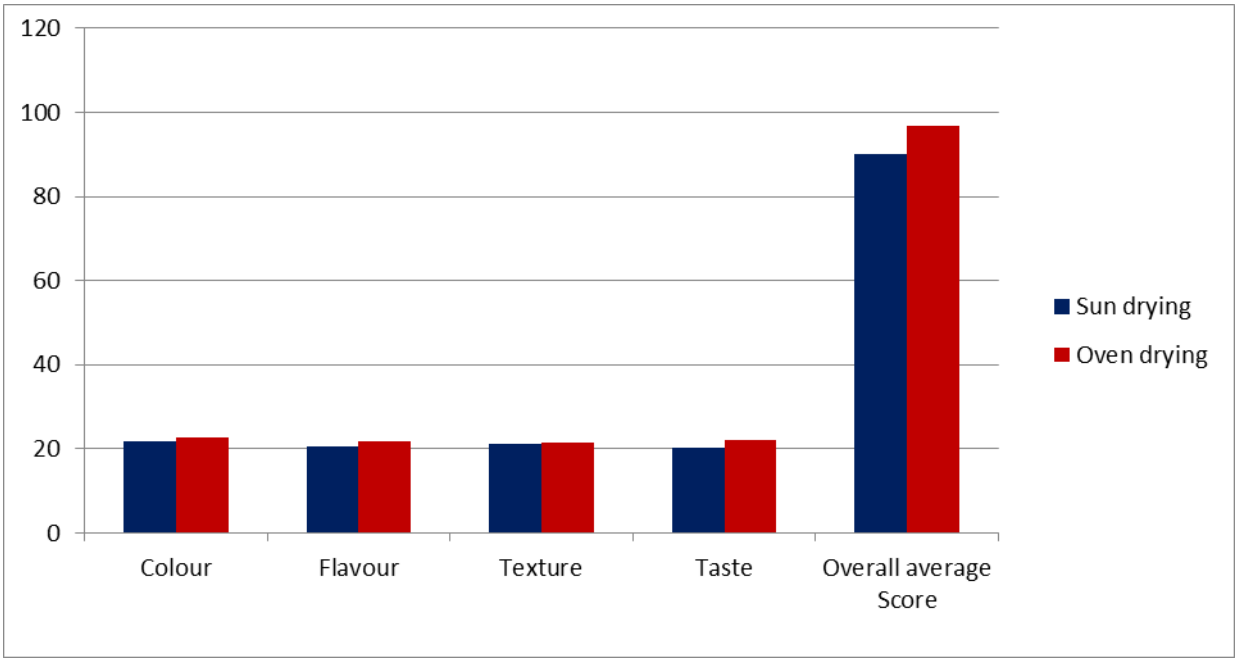

Table.1 Effect of drying methods, pre-treatments, temperature moisture content and rehydration ratio on qualities of dried mushroom

Method of drying	Treatment	Temperature (0C)	Final moisture content,% (db)	Final moisture content,% (wb)	Rehydration ratio
Sun drying	**control**	**35-40**	**8.81**	**8.10**	**3.41**
	1.0%KMS	**35-40**	**9.48**	**8.66**	**3.87**
	0.5%Citric acid		**9.50**	**8.68**	**3.82**
	0.5%KMS+0.2 %Citric acid		**9.65**	**8.80**	**3.75**
Oven drying	**1.0%KMS**	**55-60**	**8.35**	**7.71**	**5.21**
	0.5%Citric acid		**8.81**	**8.09**	**4.93**
	0.5%KMS+0.2 %Citric acid		**8.94**	**8.21**	**4.90**

Table.2 Proximate composition of fresh and dehydrated mushrooms

Constituent (g per 100)	Fresh (%)	Sundried (%)	Oven drying (%)
Moisture	88.0	9.58 ±0.16	9.03±0.05
Ash	0.78	7.48±0.07	8.40±0.08
Fat	0.20	1.33±0.25	1.69±0.19
Crude fiber	1.12	35.60±0.25	37.50±0.4
Crude Protein	2.52	20.89±0.20	23.84±4.37
Carbohydrate	5.32	60.34±0.22	57.41±4.36

Table.3 Acceptability scores of dehydrated mushrooms product stored for varying periods

Dehydration Technique	Treatments	Period of storage (in months)	Parameters				
			Colour	Flavour	Texture	Taste	Overall average score
Sun drying	control	0	5.70	6.31	6.84	7.05	25.9
	1.0%KMS	0	7.7	7.0	7.2	7.0	28.9
		3	7.4	7.2	7.5	6.7	31.8
		6	7.2	7.2	7.2	7.4	35
	Total Score	9	22.3	21.4	21.9	21.1	95.7
	0.5%Citric acid	0	7.5	6.8	7.2	6.8	28.3
		3	7.3	7.0	7.0	6.5	30.8
		6	7.0	6.4	6.3	7.0	32.7
	Total Score	9	21.8	20.2	20.5	20.3	91.8
	0.5%KMS+0.2%Citric acid	0	7.2	6.7	7.0	6.0	26.9
		3	7.0	7.0	6.5	7.0	30.5
		6	6.8	6.5	7.2	6.3	32.8
	Total Score	9	21	20.2	20.7	19.3	90.2
	Average Score	9.0	21.7	20.6	21.0	20.2	92.6
Oven drying	1.0%KMS	0	8.0	7.9	8.0	7.7	31.6
		3	7.9	7.5	8.5	8.0	34.9
		6	7.6	8.0	7.5	8.5	37.6
	Total Score	9	23.5	23.4	24	24.2	104.1
	0.5%Citric acid	0	7.7	8.0	7.0	7.5	30.2
		3	7.9	6.7	6.9	7.0	31.5
		6	7.2	7.0	6.0	7.2	33.4
	Total Score	9	22.8	21.7	19.9	21.7	95.1
	0.5%KMS+0.2%Citric acid	0	7.3	7.0	6.9	7.0	28.2
		3	7.1	6.9	7.5	6.5	31
		6	7.0	6.0	6.0	6.7	31.7
	Total Score	9	21.4	19.9	20.4	20.2	90.9
	Average Score	9.0	22.6	21.7	21.4	22.0	96.7

Sensory evaluation

Mean score for the acceptability testing of product developed from dehydrated mushrooms has been presented in Table 3 and illustrated in Figure 2.

As per the reference to be drawn from the 9 point hedonic scale the scores obtained for all the sensory qualities are between liked much to liked very much range for both the sun dried and oven dried mushrooms samples. But oven dried sample has comparatively higher score than sun dried sample which indicates higher preference by the respondents. From the study it may be concluded that oven drying took minimum effective time for drying followed by sun drying. 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. This implies that the sun drying of mushrooms is not recommended. It was statistically proved that the pretreatment with 0.5% potassium metabisulphite + 0.2% citric acid gave the poor results. The mushrooms dried in oven dryer using pretreatment of 1.0% potassium metabisulphite gave the maximum values of L i.e. whiteness, rehydration ratio and coefficient of rehydration.

The drying time and final moisture content was also comparatively less than the mushrooms dried in oven dryer as compare to open sun drying.

It can be concluded that small-scale preservation of fruits and vegetables, such as mushroom preservation at the household level, is important to improving food security as food wastage prevents households from obtaining the food needed for adequate diets. So that the oven drying particularly in dryer with samples treated with 1.0% potassium metabisulphite gave the best results and the shelf life of the mushrooms could be extended by the farmers. It is recommended that fresh mushroom is preserved by Oven dryer prior to drying using preservatives to avoid food spoilage and ensure food security at the household level.

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