

**A COMPARITIVE STUDY ON ACCEPTABILITY,
SHELF LIFE AND SELECTED NUTRIENTS OF
THREE COMMON VARIETIES OF MUSHROOM
AVAILABLE IN MARKET**

By

ACHANTA SRIDEVI

A THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND
HIGHER EDUCATION FOR WOMEN - DEEMED UNIVERSITY, COIMBATORE - 641 043
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE IN FAMILY AND COMMUNITY SCIENCE

MAY - 1999

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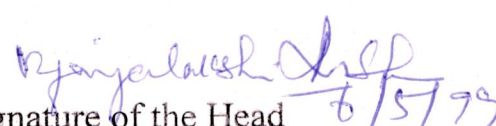
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Certified as Bonafide Research Work


Signature of the Head
of the Department


Signature of
the Guide



De l'Amour et de la Vie

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Contents

LIST OF CONTENTS

CHAPTER		PAGE NO.
	LIST OF TABLES	
	LIST OF FIGURES	
	LIST OF PLATES	
	LIST OF APENDICES	
I	INTRODUCTION	1
II	REIVEW OF LITERATURE	
	1. Present trend in production of mushrooms	7
	2. Consumption of mushrooms	9
	3. Nutritive and medicinal values of mushrooms	12
	4. Constraints in mushroom cultivation	15
	5. Preservation techniques	18
III	EXPERIMENTAL PROCEDURE	
	A. Drying the three varieties of mushrooms and analysing its nutrient content	22
	B. Finding out the keeping quality of mushrooms in its fresh and dried forms	26
	C. Preparing few delicacies using fresh and dried form of three varieties of mushrooms and observing the acceptability	27
	D. Finding out the nutrient content of selected dishes prepared	29

IV RESULTS AND DISCUSSION

- A. Time taken for drying three varieties of mushrooms and
nutrient content of dried mushrooms

30

- Information on the keeping quality of three varieties of
mushrooms in fresh and dried forms

36

- The acceptability of delicacies prepared using three varieties of
mushrooms in fresh and dried forms

39

- D. Calculation of the nutrients and cost incurred for dishes prepared

49

V SUMMARY AND CONCLUSION

54

BIBLIOGRAPHY

APPENDICES

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
I	TIME TAKEN FOR DRYING SELECTED THREE VARIETIES OF MUSHROOM	31
II	WEIGHT LOST IN DRYING SELECTED VARIETIES OF MUSHROOM	32
III	REHYDRATION CAPACITY OF DRIED MUSHROOMS	33
IV A	NUTRIENTS PRESENT IN FRESH SAMPLE OF THE SELECTED VARIETIES OF MUSHROOM	34
IV B	NUTRIENTS PRESENT IN DRIED SAMPLE OF THE SELECTED VARIETIES OF MUSHROOM	35
V	THE PHYSICAL CHANGES THAT TOOK PLACE WHILE STORING THE SELECTED MUSHROOMS	37
VI	SCORES OBTAINED BY VARIOUS DELICACIES PREPARED FROM FRESH BUTTON, OYSTER AND MILKY MUSHROOMS	40

VII	SCORES OBTAINED BY THE DELICACIES PREPARED WITH DRIED BUTTON, OYSTER AND MILKY MUSHROOMS	42
VIII	PERCENTAGE OF SCORES OBTAINED BY MUSHROOM DELICACIES OF FRESH AND DRIED FORM OF SELECTED VARIETIES	44
IX	MEAN \pm SD VALUES OBTAINED FOR VARIOUS DELICACIES WITH TEST OF SIGNIFICANCE FOR FRESH MUSHROOMS	46
X	MEAN \pm SD VALUES OBTAINED FOR VARIOUS DELICACIES WITH TEST OF SIGNIFICANCE FOR DRIED MUSHROOMS	48
XI	NUTRIENT CONTENT OF PREPARED DELICACIES USING SELECTED VARIETIES OF MUSHROOMS	49
XII	THE COST INCURRED FOR PREPARING VARIOUS DELICACIES USING SELECTED VARIETY OF FRESH MUSHROOMS	52

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO
I	REHYDRATION CAPACITY OF DRIED MUSHROOMS-COMPARISON CHART	33a
1.	NUTRIENTS PRESENT IN FRESH SAMPLE OF THE SELECTED VARIETIES OF MUSHROOM	34a
3a.	PERCENTAGE OF SCORES OBTAINED BY MUSHROOM DELICACIES PREPARED WITH FRESH AND DRIED BUTTON MUSHROOM	45a
3b.	PERCENTAGE OF SCORES OBTAINED BY MUSHROOM DELICACIES PREPARED WITH FRESH AND DRIED OYSTER MUSHROOM	45b
3c.	PERCENTAGE OF SCORES OBTAINED BY MUSHROOM DELICACIES PREPARED WITH FRESH AND DRIED VARIETIES OF MILKY MUSHROOM	45c

LIST OF PLATES

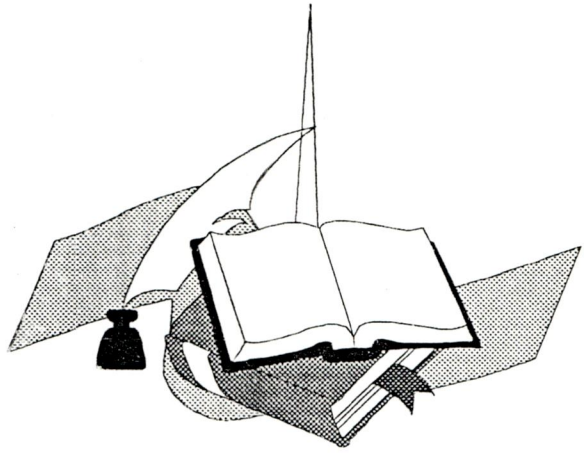
Plate No

- 2.** Fresh mushroom and deteriorating mushrooms on third day
- 4.** Button, Oyster and Milky mushroom in its fresh and dried forms

LIST OF APPENDICES

Appendix No

- | | |
|------|---|
| Ia. | Estimation of protein |
| Ib. | Estimation of ascorbic acid by dye method |
| Ic. | Determination of fibre content |
| II. | Score card to see the changes occurring while storage |
| III. | Recipes |
| IV. | Score card for recipes |



Introduction

I. INTRODUCTION

India is the one of the oldest civilization with a rich cultural heritage. It has become self sufficient in agricultural production and is now the tenth industrialized country in the world. With regard to its population it is the home of 16 percent of world's population, in 2.42 percent of the total world area. The alarming increase in the population of the country has created a burden on the limited resources. At present India has over 840 million people and about 30 per cent of its population is living on meagre resources that are barely adequate to replenish daily individual nutritional requirement.

Due to the population explosion one of the striking effect of the demographic, social and structural changes that took place during last four decades in India, is the alarming increase in the number of unemployed or severly under employed rural work force. Unemployment in turn is the cause of poverty. Because of all these problems "food for all" is still a distant dream, which leads to malnutrition. Malnutrition is one of the factors responsible for high mortality and morbidity in the country. Due to the population explosion the problem of protein deficiency has become more and more acute. Hence today's challenge is achieving food security at house holed level.

Under these prevailing circumstances a new venture should be undertaken and accomplish all the above goals of producing a nutritious food in available space, at reasonable cost by engaging the unemployed and

under employed population. Mushroom cultivation can be started as socio-economic programme which can create employment potentials at high levels. It can also serve as an alternative source for protein production and save the nation from acute malnutrition and protein hunger. As our country is rich in agrowastes and residues, mushroom cultivation will be a easy task to undertake, which can convert wastes into valuable proteinaceous foods, and also it does not demand much land space. Thus mushroom cultivation is an ideal and suitable agriculture based activity for developing country like India.

Mushroom is the fruit body of a fungus, a separate group of organisms that cannot produce their own food like green plants, and depends for food on other living organic material (Dhar,1994). Chang (1990) poetically described mushrooms as "without leaves, without buds, without flowers yet they form fruits".

There are around 38,000 mushroom varieties known to exist in nature. As many as 2000 edible species of mushrooms have been recorded out of which 300 species are known to occur in India. (Ganesh Kumar et al, 1997). Presently three mushrooms namely *Agaricus bisporus* (white button mushroom), *Pleurotus spp* (Oyster mushroom) and *Volvariella Volvacea* (Tropical mushroom) are under commercial cultivation in India. Of these, white button and oyster mushrooms have become popular throughout the country (Chadha, 1992). Another mushroom which is trying to get worthy position at present is milky mushroom, (*Calocybe Indica*).

Mushroom cultivation was first started in 1943 at Coimbatore in Tamilnadu when paddy straw mushroom was successfully cultivated on paddystraw. In 1961 cultivation of button mushroom was initiated at Solan in Himachal Pradesh (Chanda, 1994). Till 1980 mushroom cultivation was restricted to hilly regions of northern states. Later the farmers in plains also started growing than crop on commercial scale. Milky white mushroom was first reported in 1974, from the city of Calcutta. Again in 1998, Regional research station, TNAU, Aruppukottai introduced APK-2 milky mushroom for commercial cultivation which can grow well at 25-35⁰C and at a relative humidity of more than 80 per cent (Krishnamoorthy, et al., 1998).

Mushrooms can be grown on various agro wastes and if 0.5 per cent of total crop residue that India produces is utilised about 3,00,000 tonnes of mushrooms per annum could be produced. Nutritionally speaking, mushrooms are rich sources of protein and low in fat and carbohydrate, rich in fibre content and a good source of Vitamins such as ascorbic acid, thiamine, riboflavin and niacin. Little phosphorous, potassium and very little of and calcium are also present in the form of minerals.

Other than being rich in its nutrient, it also serve as a good medicinal product for various ailments. Medicinal uses of mushrooms were known from ancient times. Many varieties of medicinal mushrooms are there. Mushrooms are anti-cancerous, liver protective agents, recuperating agents for stomach and intestine, medicine for stimulating the bile secretions are some that could be mentioned. (Balakrishnan, 1992). Mushrooms are regarded as fascinating food item recently for its excellent

flavour, texture and taste. New mushrooms food products are available in the form of various mushroom toppings or sauces in fast food outlets. According to Sethi and Anand (1983) both dried and fresh mushrooms are used as a delicacy in a variety of food stuffs like stew, pickles, soup and pulao.

As a food, as a tonic, as a medicine, the entire creation is precious (Chang, 1990). Realizing its nutritional and medicinal values many entrepreneurs have taken up cultivation of mushrooms. It gets slowly pick up in India. During last 10 years, the production of mushrooms in India has registered 7.3 fold increase with an annual growth rate of 24 percent. The output rose from about a 1000 tonnes 1990-91 to nearly 32,000 tonnes in 1995-96. Thus it is not only supporting the economy of nation but also giving self employment for youth and women. It is an activity where 80 percent of the women are involved in the production. Mushrooms are excellent commodity to be grown by landless people and small scale farmers. It could be a successful entrepreneurship if it is supported by efficient marketing system.

The marketing of mushrooms is growing increasingly competitive, though prices vary. Major constraint in the mushroom production and marketing is that the shelf life of mushrooms, which is very short. The post harvest metabolic changes causes irreversible quality changes such as change of texture, flavour and weight loss. Saxena, (1993). In such conditions transporting the mushrooms becomes a major problem as

the most growers depend upon public rail, road or air transport which do not guarantee to deliver the produce at the destination on time. To prevent the spoiling at these times they should be stored at suitable temperatures.

In order to protect mushroom from all these post harvest changes, suitable technology should be introduced to develop a highly resistant strain which can withstand the tropical and subtropical temperatures, and also a method of preservation which could be adopted to preserve the produce for few days at least. Though many techniques like dehydration, canning and freezing are there, but they are not at reachable level for small scale growers. For short term storage they can be wrapped in polythene bags and can be transported safely. (Sanjeev saxena, 1993). But for longterm storage there is need to develop low cost preservation method to ameliorate the problem. Dehydration by sundrying is one of the best methods to follow even by small scale growers, which is cheapest and easy to follow. (Saxena and Raj, 1989).

Very little work has been done on preservation techniques of different mushrooms in the country. This is the major problems faced by the growers as the shelflife of mushrooms is very short.

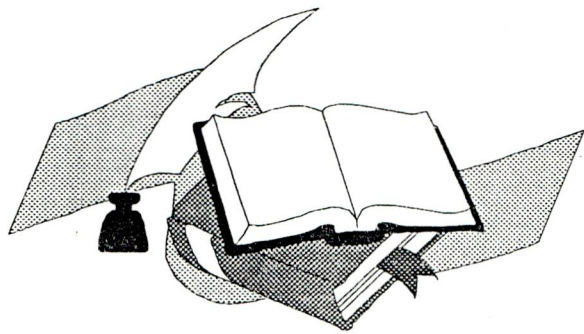
Though the newly introduced milky mushroom has positive aspects such as more profit to the cultivators, greater shelf life of 3 to 5 days under normal conditions, it is not yet popular among the consumers. Besides no information is available on the acceptability of the newly introduced mushroom. Hence the investigator has taken up this study to

know the acceptability of milky white mushroom, its shelf life and nutritive values along with other two varieties namely button and oyster mushrooms with the following objectives.

OBJECTIVES

1. To dry the selected species of mushroom in sun and not air oven and to find out the best method of drying based on the selected nutrients retained.
2. To compare selected nutrients and shelf-life of fresh and dried mushrooms
3. Preparing few delicacies using the selected mushrooms in its dried and fresh forms and evaluating its acceptancy and
4. Calculating the nutritional values of selected dishes prepared.

It is hoped the information obtained from this study will help to popularise milky mushroom among the consumers by which the cultivators also will be encouraged to produce more of the varieties and benefit out of it.



Review of Literature

II. REVIEW OF LITERATURE

The literature collected for the study are reviewed under the following heads.

- A. Present trend in Production of Mushrooms
- B. Consumption of Mushrooms
- C. Nutritive and medicinal values of mushrooms
- D. Constraints in mushroom cultivation and
- E. Preservation techniques

A. Present trend in production of Mushrooms:

Mushrooms is thought to be derived from the French word mouse or moss. The vedas describe them as Food for the Gods. (Tiwari 1993). Till the middle of the seventeenth century mushrooms grew wild, in dark and lonely areas. But in several European countries, people believed that even a touch of mushroom could spell disaster. A frenchman discovered the secret of button mushroom cultivation, sometime in the mid seventeenth century. During the succeeding centuries button mushroom cultivation had spread to other countries and became popular in India too (Indian farmer times, 1988). Chadha, (1994), inform that other than button mushroom, few other varieties of edible mushrooms are also being cultivated in different parts of the world. These include, paddy straw mushroom (*volvariella* spp), shaggy ink cap (*Coprinus* spp), milky white mushroom (*calocybe Indica*), strophaire mushroom (*Strophasia*) and enokitake (*Flammulina velutipes*).

1. World Trade

Harander Raj (1998), states that bulk of the world's mushroom production is contributed by America and other European countries with a share of around 80 per cent. Among Asian countries, China and Indonesia are the leading producers of mushrooms. China started organized mushroom cultivation in 60's and during 1995-96 its production rose to 30,000 tonnes. (Food digest, 1997). In drawing up a scenario of trends in Agaricus mushroom production and trade for the Year 2000, Bullman, (1993) expects an increase in the trade with in Europe by 10 per cent (Curvetto et al., 1997). The international market of mushroom is mainly in the processed form as fresh mushroom have a very short shelf life.

2. Indian Trade

Kohil (1991), reveal that India started its organised efforts towards mushroom cultivation in 1939 in Chennai region. Trading for cultivation of oyster mushroom was started in Mysore in 1960. In 1983 National center for mushroom research training was started in Solan. The country is now gradually emerging as a regular exporter to this high value culinary product, (Food digest, 1998). Thus India is poised to enter the multimillion dollar international mushroom market following a break through in the technology of environment controlled cultivation of the delicious mushroom. Kohil 1991) Economic times, (1993), and Harender Raj (1998) profess the production of mushrooms in 1988-89 was around 1600 tonnes in the country. In 1993-94, the export of various categories of mushroom from India has been 41.53 tonnes of fresh forms, 39-40 tonnes of dried and 11.48 tonnes of preserved mushrooms valued at 23.93 crores

of rupees. Mushrooms are now not only gourments delight but also have become a money spinner for cultivators.

In India among cultivated types, button and oyster mushroom are grown in Himachal Pradesh, Uttarpradesh, Delhi, Pune, Bangalore, Mysore etc. The paddy starw mushroom are grown in small parts of southern region and Orissa. (Ganesh Kumar, 1997). New strains of mushrooms are also being introduced to meet the demand of aspiring mushroom growers Mushroom cultivation in Tamilnadu has witnessed a tremendous change in recent times. Realizing the importance of mushroom industry the union government has introduced several policies and schemes that provide required financial support for these ventures. (Harender Raj, 1998). For encouraging involvement of private enterpreneurs in the mushroom cultivation programme, the government also grant subsidy for two Years and loans for the plant and machinery, (Food digest, 1993). The easy availability of finance with subsidies, facilitates the entry of more entrepreneurs to take up the venture. (Nagarajan, 1997).

B. Consumption of Mushrooms

According to Tiwari (1993) and Lakhanpal (1995) the use of mushroom as food is not a new thing. Soma mentioned in ancient literature Rig veda, was an extract of mushroom. The Roman naturalist pliny who died in A.D 79 described and spoke of mushroom preparations which were served in special and costly utensils only to masters. It is only in last 200 years that mushrooms have been grown for human consumption and

commerce says Dhar (1994). The mushrooms have now come to occupy a very popular place in modern diet because of its nutritive value and flavour (Lakhanpal, 1994). The connoisseurs of food, love mushrooms for its fine, distinct taste and versatility of usage in a variety of food items (Prasad, 1997). Mushrooms popularly regarded as vegetarian meat, are now available in fresh, frozen and dried forms. They are ideal for inclusion in both vegetarian and non-vegetarian diets (Sudhirsingh, 1995). Mushrooms, rich in food value are being used as an article of food in many parts of the world. But in India, their consumption has not become popular as they have not attracted the common man (Gupta, 1996). Mostly the younger fruiting bodies are preferred for consumption, the older ones acquire shabby appearance and undergo autolysis (Lakhanpal, 1994). Mushrooms are normally picked at a time when the veil is not too far extended. (Vijaya Khader, 1996).

In considering the world trade in mushrooms, consumption is a logical starting point, as it creates the market. Currently, six countries account for 85 per cent of the total world consumption of *Agaricus* mushrooms namely 30 per cent for United States, 17 per cent for Germany, 11 per cent for the United Kingdom, 11 per cent for France, 10 per cent for Italy and 6 per cent for Canada. (Bullman, 1993).

Miler (1994) states the final global trend in consumption is the shift from processed (mostly tinned) towards fresh mushroom. Trend in the United States, Australia, and Canada also in general are toward greater

fresh consumption, although processed mushrooms have a significant place in the market.

In our country mushrooms are being cultivated in sufficient quantity for domestic consumption (Kumar et al., 1994). Rafique et al. (1994) conducted a survey in Gujarat to elicit information about status of mushroom cultivation and patterns of its consumption. The survey indicated only 6 per cent of them regularly used mushroom in their diet, while among institutional buyers 25 per cent offered mushrooms in their menus. In Madras city (TN) itself governments consume around 350kg of mushrooms per day. This is a sharp increase from 10-15kg in demand just a few years ago. However Coimbatore which consumes nearly 200kg per day, has an efficient marketing system, whereby availability is ensured all over the city (Anita, 1993).

The mushrooms have long been known as a popular food item in the market whether they have been grown artificially or gathered wild during season (Quimo, 1985). Prakasm et al. (1994), mentioned that mushrooms along with pulses will ultimately help in irradiation of protein malnutrition. Currently attention is being paid to the possibility of the use of mushroom as food to enrich human diets (Banik1996). In recent years the place of mushrooms in indian diet is becoming more important because of their ability to convert nutritionally worthless organic wastes into highly specialised proteinecious and delicious food with characteristic flavour suguna et al.,1995, and Murugesan 1996).

D. Nutritive and Medicinal values of Mushrooms:

1. Nutritive values:

According to Yaper **et al.** (1990), Prakash and Tejaswini (1991), mushrooms is an excellent source of proteins, vitamins and minerals and contain about 90% of moisture.

Protein :

Kumar (1997), Singh and Bhatt (1997) point out that since mushrooms contain high quality protein, they can serve as suitable protein contributing foods in order to save the nation from acute malnutrition and protein hunger. Singh (1995) and Prasad (1997), mention that mushrooms contain 20-40 per cent of high quality protein on dry weight basis and are rich in various essential aminoacids except tryptophan which is quite low. Sarala (1997) opine that the essential amino acids present are lysine, methioine, threoine, valine, leucine, isoleucine, cystine and phenyl alanine. Singh et al. (1995) believe that mushrooms are intermediate between vegetarian and non-vegetarian food stuffs. Its protein content is higher than almost all the common vegetables and some of the fruits. Meera pandey, and Tewari, (1998) are in view that even among the vegetable proteins upto 70 to 90 per cent in fresh mushrooms can be easily digestible. The digestibility is higher than that of spinach protein (73%) but poorer than that of meat protein (99%). Thus mushrooms can contribute efficiently in mitigating the large protein gap by serving as protein contributing food in developing countries, where the population mainly depends on cereal based

foods (Singh, et al., 1995). However the contribution of mushrooms to world's protein supply will be significant if they are properly utilized, (Banik, 1996).

Carbohydrates and Fats

Mushrooms are low caloric foods, completely devoid of starch (Indian farmer times, 1988). It is a good source of energy. Four hundred and fifty four grams of fresh mushrooms provide 120 K.cal. of energy (Basu, 1993). Zakia Bano (1993) surmise that mushrooms contain 63 per cent of carbohydrates and 3 per cent fat. Though these are devoid of starch as such, small amounts of glycogen is present. Sanatore (1993), confide that they contain traces of sugar and are cholestrol and fat free. Mannitol and trehalose represents a bulk of free sugars.

Major portion of carbohydrates is in polymeric form constituting the dietary fibre. (Zakia Bano **et al.**, 1993). Vijaya khadar (1996), states that the fibre content is almost like meal bread, and is nutritionally superior to the most of the vegetables. Mushrooms are rich in essential fatty acids, and linoleic acids (Sarala, 1997). The degree of unsaturation of these fatty acids bears a great influence in reducing the chances of atherosclerosis (Zakia Bano, 1993).

Vitamins and minerals

With regard to vitamins and minerals, it contains significant amount of thiamine and riboflavin and do not contain Vitamin A (Padmaja Prasad, 1997). It also contains appreciable amounts of vitamins B1, B2, C

and vitamins D,K. (Indian farmer times, 1988). Balakrishnan (1992), put forward that mushrooms also contains some vitamins like B12, niacin and pantothenic acids which are not found in green plants. Along with vitamins it also contains significant amounts of minerals like potassium, iron and phosphorous (Padmaja Prasad, 1997). Calcium and phsophrous contents help to reduce the chance of dental diseases. Iron content along with folic acid help to reduce anaemia. (Karunanithi and Santha, 1996).

2. Medicinal values of mushrooms

There are about 10,000 known species of mushrooms at present. Of them it is believed that only 7000 are edible and about 200 may have medicinal values. Mushrooms have been very popular in China, Japan and other far eastern countries (Saxena, 1998). Balakrishnan (1992) and Arjunan (1998) view that China, one of the most important mushrooms growing countries, has many mushroom medicines and have stored 107 kinds of medicinal mushrooms.

A number of species among medicinal mushrooms are wild. These wild mushrooms are easily identified by local people because they remain in touch with these in nature (Mira Madan, 1994). The medicinal properties of mushrooms mainly associated with secondary metabolites which are biologically active. They are produced and get stored in the fruiting body of mushrooms. (Ganeshkumar, 1997). Balakrishnan (1992) believe that medicinal mushrooms include, both poisonous and edible ones. A deadly poisonous mushroom commonly called as 'Fly agaric' has been used therapeutically for swollen glands, nervous trembles and epilepsy.

This is also now used in homeopathic medicines (Balakrishnan, 1992).

Mushrooms contain some water soluble polysaccharides which have been demonstrated to possess antitumour activity. Their non-starch carbohydrates and richness in fibre find increasing utility in diet therapies for hypertension, hyper lipedemia, diabetes. Thus mushroom occupy a special role in formulating diets for obesity, diabetes and coronary heart disease patients (Zakia Bano *et al.*, 1992). Since it has iron of about 15 per cent, it can be used as a medicine for treating anaemia patients (Kannan, 1998). Most of the medicinal extracts which are polysaccharide in nature strengthen the immune system with no or little side effects. (Peter oei, 1994). *Lentinus edodes* or the Shitake is one of these mushroom, found to contain antitumor, antiviral and hypocholestrolemic agents and help in preventing high blood pressure, atherosclerosis, kidney ailments, diabetes, cataract, neuralgia, gall stones, numbness of the hands and feet, haemorrhoids and also in improving sexual potency. (Ganesh Kumar, 1997). According to a study done by Soni, *et al.*, (1994) mushroom feeding significantly lowered the plasma total lipid, cholesterol and glyceride level without any effect on phospholipids.

D.Constraints in mushroom cultivation:

Mushroom production has been gaining wider acceptance and popularity in recent years says Mehetre *et al.*, (1998). Globally speaking the past thirty years have brought amazing changes and development in the mushroom industry and market, in terms of size technology, productivity,

product, market and market acceptance. (Indian Food packer, 1994). Mushrooms cultivation provides self employment for rural youth and women. Hence newly emerging farms are rapidly increasing on the one hand which may be due to easy production technology. At the same time, closure of many existing mushrooms farms due to biological and marketing constraints such as lack of finance, poor quality spawn, biotic and abiotic factors and difficulties in marketing apart from climatic, is also being reported, (Senthil Pandian, et al., 1996).

Mushroom cultivation is not possible round the year in country like India, because of its tropical climate. Moreover, the fungus grows best in the cold climate and the hilly regions are more suited for this than tropics (Ganesh Kumar, 1997). Besides winter period is also short. Sometimes because of this short period, the season advances beyond our expectations, then yield in low and the crop is attacked by diseases, (Tandon, 1994). Kumar and Vinitha (1993), opines that the mushroom industry depends for its success on the ready availability of resources like spawn. Spawn is a pure culture of mycelium growing on sterilized solid substrata, such as cereal grain. In India it is widely referred as mushroom seed. The basic input in mushroom production is spawn. Shortage of spawn growing laboratory is one of the constraints. More over the cost of spawn bottle is very high and its reliability and purity is often doubtful says Basu, (1993).

Besides all these, insects and nematodes also play an important role in destroying mushrooms as pests.(Thapa,1994). Sendhil Pandian **et al** (1994) reveal that protection of mushroom crop from biological problem like pests and diseases are very important. Among insects and pests, phorids, sciarides and cecids are well known due to attack of which the flourishing mushrooms get, devitalized and lose their vigor. Now a days it has been found that the average yield per bag or tray is quite low in our country, as compared to developed countries. It is because of the reasons that unhygienic conditions prevailing in mushroom houses (Khan, et al., 1994). Complete hygiene is the only remedial measure against these malady. (Thapa, 1994).

According to Gupta, (1993). India has not been able to produce mushrooms in large quantity due to non-availability of modern know-how in controlling temperature, inadequate training of growers, use of technology results in crop failure and high cost of produce and the fragile marketing network system. (GaneshKumar, 1997). Fresh mushrooms faced a serious problems of consumer fears about mushrooms available in market, which have been there in some parts of the country. Still fears, had lingered because neither the Government of India nor private entrepreneurs educated the masses about absolute safety of cultivated mushrooms (Kohil, 1991).

Sivaprakasam and Seetharam (1995) feel that the growers experience difficulties in disposal of their produce due to lack of adequate market.

The important constraint in marketing of mushrooms is that the shelf life of mushrooms, as it is very short and the post harvest metabolic changes causes irreversible changes within hours of storage which results in rapid deterioration in the consumer acceptability of mushrooms. (Sanjeev Saxena, 1993). Hence processing assumes a greater importance in this context, to extent their shelf life (Zakia Bano **et al.**, 1992).

E.Preservation of mushrooms

Mushrooms are extremely perishable and following harvest they continue to grow, thus having short shelf life. Proper harvesting procedures are to be followed to avoid any damage of the fruit body. (Saxena, 1993). Physiological and morphological changes lead to breaking of the veil, expansion of the cap, elongation of the stem, darkening of gills, which together make the mushroom unacceptable for the consumption. Roy **et al.**, (1993), Zakia Bano (1993), Lascano, (1994), Subbaraja **et al.** (1994), opine that moisture content is an important criterion in the determination of the quality of fresh mushrooms. In general mushrooms contain 90 per cent moisture. Hence they easily deteriorate at higher temperature during summer months. In order to minimize the deterioration they have to be carefully handled.

The lack of protective covering of suberin or cutin unlike most of the fresh fruits and vegetables also prone to fast deterioration. It is further activated by fast rate of respiration says Zakia Bano and Rajarathnam (1994). Being highly perishable they cannot afford to have their own canning facilities to dispose off this crop immediately because of

low level of production and financial constraints. So, to solve the problem, work has been undertaken to preserve fresh mushrooms in a simple way for enhancing their shelf life for off seasonal use into various forms. (Sethi et al., 1991).

According to Saxena (1993), the shelf life of fresh forms can be increased by storage at very cold temperatures and wrapping in plastic film and cooled after harvesting for sale under ideal conditions. The plastic film gives good protection from water loss. (Peter oei, 1991). If they are stored in such conditions the shelf life can be increased by ten days and are ensured to reach the customer in a better condition for fresh sale even if delayed.

Zakia Bano et al., (1993) list some methods for the preservation such as dehydration, canning, lacticacid fermentaion, steeping and freezing preservation.

Dehydration is a widely used method for long-term storage of mushroom. (Saxena and Rai 1989). Kohil, (1991) reveal that sundrying is a traditional method in places having high rate of insolation, (Kohil, 1991). Although sun drying might be the most economical it requires enough exposure to sunlight Marimuthu et al., (1989) (Zakai Bano 1994), recommended a drying air temperature of 50⁰C for mushroom. Pruthi et al., (1978) Mudahar and Bains (1982) stress that, pretreatment is necessary to check discolouration during mushroom processing. Drying in flow drier at

60°C requires 5 to 6 hr to dry the mushrooms to a moisture content of 5 per cent. The best dehydrated product is obtained by freeze drying samples. Suguna **et al.**, (1995) did a study on dehydration of mushrooms by Sun drying, thin-layer drying, fluidized bed drying and solar cabinet drying. They found that the optimum fluidizing bed drying temperature was found to be 50°C, with an air flow at 35M³/min. Trials with natural convection solar cabinet dryer showed a drying time of 7 hours when ambient temperature varied between 29 and 32°C. Sun drying product had better rehydration capacity.

Canning:

Mushrooms can be successfully canned in brine. Preservation in 20% salt solution and 6 per cent vinegar concentration will be helpful, inform Subbaraja, (1994). This is the most common method for the long term storage of *Agaricus bisporus*, and various entrepreneurs in private and public sector has developed the technology of canning with minimum blanching losses and maximum whiteness. (Chadha, 1992). Zakia Bano (1992) affirms that the product can be stored up to 4-12 months respectively, based on the internal appearance of cans and external appearance of product.

Steeping:

Steeping is one of the methods of preserving mushrooms for long time. Mushrooms can be steeped in safe preservatives with different concentrations. One of the best solution for maintaining the whiteness of

mushrooms for long period is 5 per cent Sodium Chloride (salt)+ 1.2 per cent acetic acid + 0.1 per cent sodium metabisulphate +1 per cent alum. It gave better results for oyster mushroom than button mushroom (Kumar and Anita).

Alpana singh et al., (1996) recommends steeping of mushroom after blanching in higher temperature concentration of potassium metabisulphate, acetic acid, citric acid, and sodium bicarbonate in order to extend the shelf life.

Freezing

Zakia Bano, (1992, 1994) revealed that freeze drying process consumes large amounts of energy, but there is no need for cooling the mushrooms during transport, storing in freezer for 3 months at -30°C was found acceptable. Blanching in steam at 100°C was recommended necessary since a strong off-flavour was detected from unblanched samples at the end of the storage period. According to her, taste and flavour are kept, but high investment is needed for the equipment.



Experimental Procedure

III. EXPERIMENTAL PROCEDURE

A Comparative Study on Acceptability, Shelf life and selected nutrients of Three Common Varieties of Mushroom Available in the Market, consisted of the following aspects.

- A. Drying the three varieties of mushroom and analysing its nutrient content
- B. Finding out the keeping quality of mushrooms in its fresh and dried form
- C. Preparing few delicacies using fresh and dried form of three varieties of mushrooms, and observing the acceptability
- D. Finding out nutrient content of the selected dishes prepared

In a preliminary survey conducted in the market, it revealed that three varieties of mushroom mainly button ,oyster and milky mushroom were available. Hence the investigator selected these three varieties for her experiment.

A. DRYING THE THREE VARIETIES OF MUSHROOMS AND ANALYSING ITS NUTRIENT CONTENT

In order to minimise deterioration of fresh mushrooms they have to be carefully handled and disposed off quickly to the market by packing them in polythene packets. (Subbaraja ,1994). Dehydration is a

widely used method for long term storage of mushroom (Saxena et al.1989). Drying is an ancient method for food preservation. In this method water is removed or tied so that it is not available for microbial growth, so that the dried food has quite long life (Saknkhe et al. 1991).

Therefore drying was carried out for the three varieties of mushrooms. This drying process was done according to a study done by Nehru et al. (1995)

The study revealed that there was no loss in protein, total sugar, total free amino acid contents of mushrooms treated with 0.5% potassium meta bisulphate while there was a loss of 7% protein, 6% total sugar and 6% free amino acid during blanching. Hence blanching pre-treatment was considered undesirable.

Therefore mushrooms were pre-treated with 0.5% potassium meta bisulphate for 15 minutes. For each 50 g of mushrooms 100 ml of solution was used. This drying process involved the following steps.

1. Cleaning the fresh mushrooms and cutting into small pieces of (1x2) size.
2. Weighing the mushrooms.
3. Soaking the weighed mushrooms in 0.5% potassium meta bisulphate solution, for about 15 minutes.
4. Draining the excess water and allowing it to dry.

These steps were followed for all the three varieties of mushrooms. After these pre treated mushrooms were kept for drying. This drying was done in three methods respectively (a) traditional sun drying (b)drying in solar drier (c) Drying in hot air oven.

(a)Traditional Sun drying

Sun drying is the simplest dehydration process which is common in the tropics. Its principle advantage is that it is very cheap but not very sanitary. (Muller, 1988) .Mushrooms were dried under this conditions by keeping, directly under sun in an aluminium tray between 10 am and 4pm.

(b) Drying in solar drier

Same amount of pre treated mushroom were taken and kept in pre heated solar drier in an aluminium tray. According to Nehru et al.,(1995). Mushrooms can be dried by non conventional energy source in this method, at farm level at a cheaper cost.

(c) Drying in Hot air oven

The same amount of mushrooms were taken and pre treated. Drained the water completely. Before keeping in oven mushrooms were

wrapped in filter paper. So that there won't be any outside moisture. These mushrooms were kept in watch glass and dried in oven at 90°C. The time taken for drying of mushrooms by all the three methods is given in chapter IV.

All the samples were dried until the moisture content is at 5% level

II NUTRIENT ANALYSIS OF THE DRIED SAMPLE

From the above dried products, 5gm of each mushroom sample was weighed and taken for the nutrient analysis. These samples were tested for protein, calcium, crude fibre and ascorbic acid. This analysis was done by following the standard procedures, which are given in appendix I. This nutritive analysis was done to know the best method of drying among the three methods in which the nutrient loss is meagre. The nutrient analysis revealed that the nutrient loss was less in sun drying compared to other two methods. It indicated that, among the three methods (i.e. sun drying, solar drying and drying in hot air oven), drying in direct sun is the best method to follow.

Therefore required amount of all the three varieties button, oyster and milky mushrooms were dried in sun by following the method stated above.

III. FINDING OUT THE KEEPING QUALITY OF FRESH AND DRIED MUSHROOMS

To know the keeping qualities of fresh button, oyster and milky mushrooms the mushrooms were kept under the following conditions.

1. Fresh samples kept in room temperature
2. Fresh samples kept in refrigerator

Fifty grams of each variety of mushrooms namely button, oyster and milky mushroom were taken and kept in the above conditions. A panel of 5 members were selected to note the changes in various aspects like colour, flavour, appearance, and size for every 24 hours.

Mushrooms lack a protective covering cutin or suberin thus it is prone to fast deterioration, which will lead to development of off flavour. (Zakia Bano et al., 1993). And also on storage the fruit bodies turn brown, shrivel, loose weight with opening of veil, elongation of stripe, wilting and softening of texture takes place rendering the produce unsaleable (Dhar, 1992). Therefore note all these changes, the panel members were given a score card with characteristic qualities and their deterioration changes, for each mushroom separately. The score card is given in appendix II.

This observation was continued till the mushroom became unfit for use, as given by panel members. This was repeated three times, so that if there was any error, it could be avoided.

From the sun dried samples of 3 varieties of mushroom 20g of dried weight was weighed and taken for observation. They were kept in separate polythene bags which were sealed and stored in cool place. These samples were observed at the end of every week. It was continued for three months. This process was done mainly to see the time taken for the dried sample to turn out to be unfit for consumption.

IV PREPARATION OF FEW DELICACIES USING THE MUSHROOMS IN FRESH AND DRIED FORMS

To find out the acceptancy of the selected dishes they were prepared with all the three varieties of mushroom button, oyster and milky mushroom both using fresh mushrooms as well as dried mushrooms. Before using dried sample for cooking, they were subjected to rehydration.

(a) Rehydration of dried samples

Sun dried samples from the three varieties of mushrooms were taken. When it was dried there was remarkable difference in its weight. When these dried mushrooms were rehydrated it gained weight. Therefore to standardise the amount of dried mushroom equivalent to the fresh weight of mushroom after rehydration, 10g of dried mushroom was taken from the dried samples of all three varieties of mushroom. These were rehydrated by boiling for 15 minutes. This was repeated three times to standardise equivalent weight for that of fresh mushrooms. These rehydrated mushrooms were used for preparing the selected dishes.

(b) Preparation of recipes

For the preparation, already standardised recipes were selected. About 8 recipes were selected, such that there are two preparation for each meal namely break fast, lunch, tea and dinner care was taken so that a minimum 1:2 proportion of mushroom along with other ingredients. This facilitate for the evaluation of organoleptic qualities accurately. All these delicacies were cooked using all the three varieties of mushrooms in its fresh and dried forms and subjected to food acceptance test.

(c) Conduction of food acceptance test

The issues involved in designing and conducting a laboratory food acceptance test are

1. Testing environment and panel selection
2. Panel training or instructions
3. Food sample selection and preparation
4. Analysis of Accepted data (Piggot, 1984)

1. Testing environment and panel selection

Testing environment should be in a convenient area. The panel members should have their individual taste. The venue selected for the preparation of these recipes selected was the foods lab of Avinashilingam University. Panel members to come at the required time panel members selected were more or less of the same age group(20-22yrs) and they were six in number.

2. Selection and preparation of items

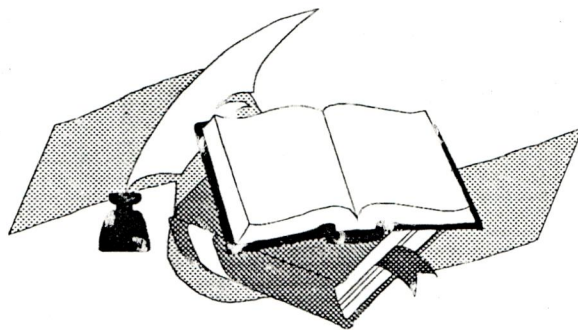
Standardised Recipes were selected and prepared using both fresh and dry samples. From these each item was prepared thrice to avoid any possible error in the experiment. The products prepared from different varieties both fresh and dry form of mushrooms were subjected to sensory analysis on the basis of various quality attributes, like taste, texture, flavour, and appearance.

3. Analysis and prepared items for its acceptance

The prepared recipes from all the three varieties were compared by the panel members using given score cards and the ranks were given in the score card.

D. FINDING OUT THE NUTRIENT CONTENT OF SELECTED DISHES PREPARED

The prepared recipes were calculated for the cost of item prepared were calculated selected nutritive values following the values in the NIN Bulletin. Calculated cost and nutritive values are presented in chapter IV.



Results and Discussion

IV. RESULTS AND DISCUSSION

The results of “A comparative study on acceptability, shelf life and selected nutrients of three common varieties of mushroom available in the market” are discussed under the following heads.

- A. Time taken for drying the three varieties of mushroom and nutrient content of the dried mushroom
- B. Information on the keeping quality of three varieties of mushroom in fresh and dried forms
- C. The acceptability of the delicacies prepared using the varieties of mushrooms in fresh and dried forms and
- D. Calculation of the nutrient content and the cost of the dishes prepared.

A. TIME TAKEN FOR DRYING THE THREE VARIETIES OF MUSHROOM AND NUTRIENT CONTENT OF THE DRIED MUSHROOM

Like all fleshy fruits and vegetables, mushrooms are highly perishable because of their high moisture content and delicate nature, and cannot be stored for more than 24 hours at ambient temperature (Kaushal and Sharma 1995). This aspect is discussed under the topics given below

1. Time taken for drying
2. Weight lost on drying
3. Rehydration capacity of dried mushrooms.
4. Nutrient analysis of fresh and dried mushrooms samples.

1. Time Taken for Drying

The drying process was done for selected three varieties of mushroom namely button, oyster and milky white mushrooms by traditional sun drying, drying in solar dryer and hot air oven at an atmospheric temperature which ranged between 36° to 38°C. The time taken for drying is given in Table 1

TABLE I
TIME TAKEN FOR DRYING SELECTED THREE VARIETIES
OF MUSHROOM

S.No.	METHOD	Button	Oyster	Milky white
1.	Traditional sun drying	12 hours	12 hours	15 ½ hours
2.	Solar drier	9 ½ hours	9 ½ hours	12 hours
3.	Hot air oven	5 hours	4 ½ hours	6 hours

The table reveals that among the three methods adopted in drying the mushrooms, hot air oven took less time for all the three varieties, where as for the samples dried in solar drier took 4 ½ to 6 hours more while the traditional sun dried samples required 7 to 9 ½ hours more to dry the mushrooms until 5 per cent moisture level. Due to the bulky nature of milky mushroom, all the three methods took more time, for drying when compared to button and oyster mushroom. Plate 1 Shows fresh and dried mushrooms.



Fresh and dried Button



Fresh and dried Oyster



Fresh and dried Milky

Plate 1. Button, Oyster and Milky Mushroom in its fresh and dried forms

2. Weight Lost in Drying

Mushrooms have high moisture content. The data, on the moisture content lost while drying the three varieties of mushroom is given in Table II

TABLE II
WEIGHT LOST IN DRYING THE SELECTED VARIETIES OF
MUSHROOM

S.No	Variety	Fresh weight (g)	Traditional sun drying		Using solar drier		Using Hot air oven	
			Actual (wt)	Percentage of moisture loss	Actual (wt)	Percentage of moisture loss	Actual (wt)	Percentage of moisture loss
1.	Button	100	9.50	90.5	9.50	90.5	9.50	90.5
2.	Oyster	100	10.0	90.0	10.0	90.0	10.0	90.0
3.	Milky	100	10.5	89.5	10.5	89.5	10.5	89.5

When 100g of button, oyster and milky mushrooms were dried, due to it is high moisture content, the weight was reduced to 9.5g, 10g, 10.5g for button, oyster and milky mushrooms respectively by losing 90.5 per cent 90 per cent and 89.5 per cent moisture. This indicates the moisture content of oyster mushroom is more when compared to button and milky mushrooms.

3. Rehydration capacity of dried mushrooms

All the three varieties of dried mushrooms were boiled in hot water for 15 minutes and spread on a filter paper until excess water is removed and weighed using a sensitive balance. The weight gained by the mushroom is given in Table III and Figure. 1

TABLE III
REHYDRATION CAPACITY OF DRIED MUSHROOMS

Variety of mushroom	Rehydration capacity by weight every five minutes		
	5 Minutes	10 Minutes	15 Minutes
Button	20.5	22.2	21
Oyster	18	17.0	17.4
Milky	16.7	17.3	18.3

Ten grams of dried mushroom of three varieties when boiled for five minutes increased to 20.5 g for button mushroom, 18 g for oyster and 16.7 g for milky mushroom. While button and milky mushroom increased to 22.2 g and 17.3 g after 10 minutes respectively oyster mushroom reduced to 17 g. When further boiled for 15 minutes button mushroom decreased to 21g while oyster and milky mushroom increased to 17.4 g and 18.3g respectively. Thus button ,oyster and milky mushroom increased by 110 per cent , 74 per cent and 83 per cent on its dry weight respectively.

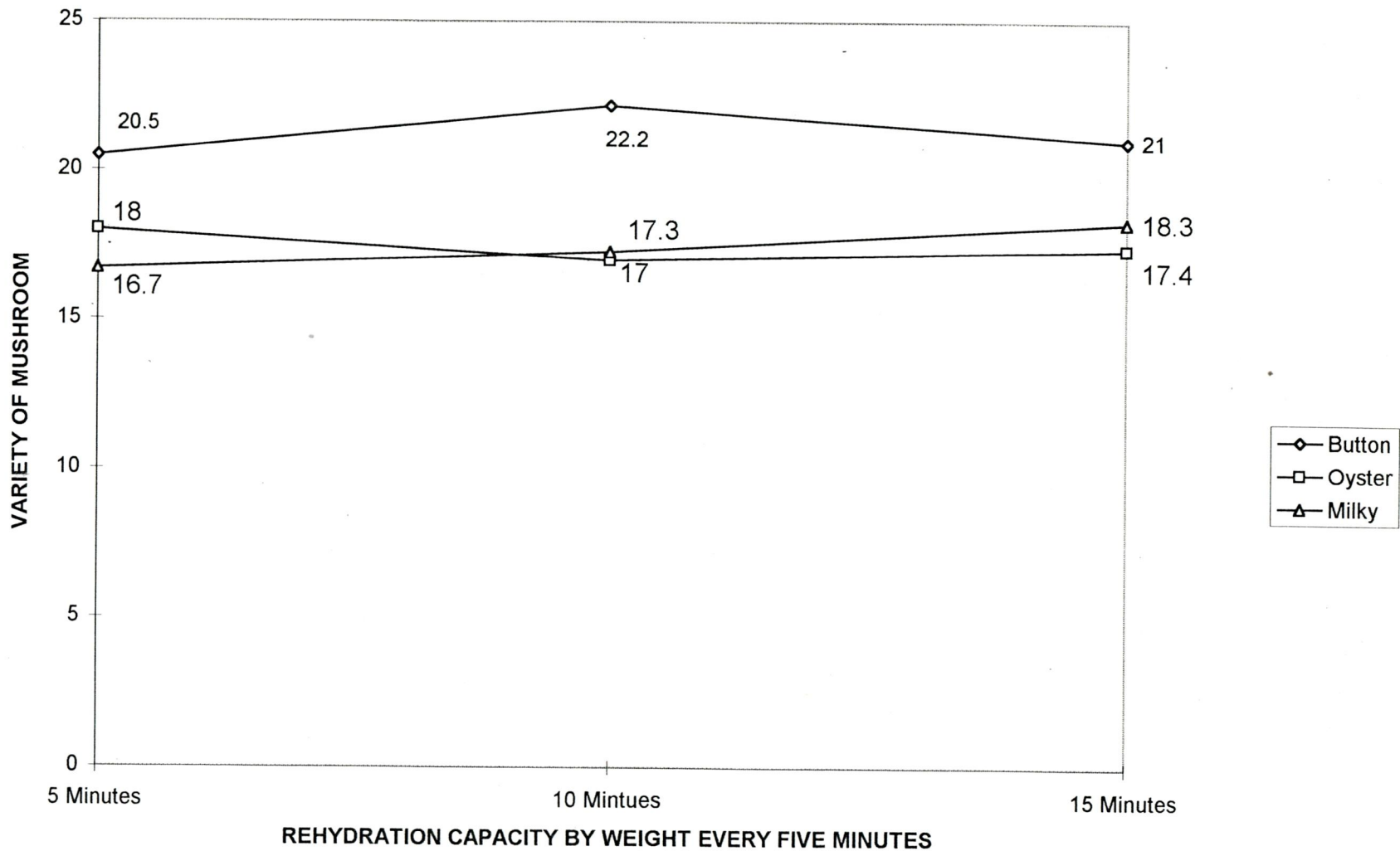


FIGURE 1
REHYDRATION CAPACITY OF DRIED MUSHROOMS - COMPARISON CHART

4.Nutrient Analysis of Fresh and Dried Mushroom Samples:

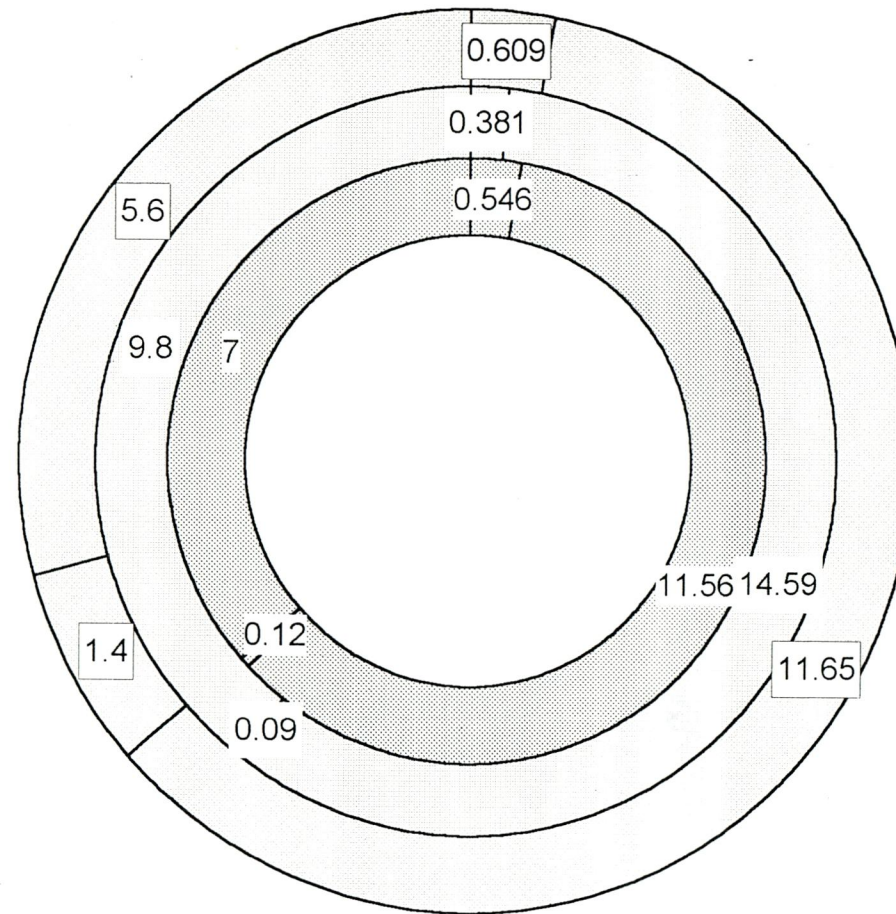
The selected nutrient analysed for fresh and dried sample were protein, calcium, crude fibre and ascorbic acid.

The selected nutrients present in fresh sample are given in Table IV A

TABLE IV A
NUTRIENTS PRESENT IN FRESH SAMPLE OF THE SELECTED
VARIETIES OF MUSHROOM

Nutrients in Percentage					
S.No	Varieties	Crude fibre	Protein	Calcium	Ascorbic acid
1.	Button	0.546	11.56	0.12	7
2.	Oyster	0.381	14.59	0.09	9.8
3.	Milky	0.609	11.65	1.4	5.6

The table IV A reveal that among the three varieties of mushroom the crude fibre content was more in milky mushroom which may be due to fibrey nature. Protein and ascorbic acid content was 14.59 per cent and 9.8 per cent in oyster mushroom. As the oyster mushroom are cultivated in Coimbatore itself and available in fresh form may be the reason for the presence of more ascorbic acid high in it. As the other two varieties took time to reach the market the ascorbic acid present may also be less in it. Maximum of 1.4 per cent of calcium was noticed in milky mushroom. Fig.2



- Crude fibre percent
- Protein percent
- Calcium percent
- Ascorbic acid percent

FIGURE 2
NUTRIENTS PRESENT IN FRESH SAMPLE OF
THE SELECTED VARIETIES OF MUSHROOM

Shows the nutrients present in fresh sample of the selected varieties of mushroom.

The selected nutrients present in dried sample is given in Table IV B

TABLE IV B
NUTRIENTS PRESENT IN DRIED SAMPLE OF THE SELECTED
VARIETIES OF MUSHROOM

S.No	Selected Nutrients per cent	Traditional sun drying			Solar dryer			Hot air oven		
		Button	Oyster	Milky	Button	Oyster	Milky	Button	Oyster	Milky
1.	Protein	17	18	15.6	17.5	16	15.5	13	14	13
2.	Calcium	0.2	0.2	0.27	0.27	0.27	0.27	0.27	0.12	0.31
3.	Crude fibre	9	8.7	7.8	8	6	7.5	4	5	4
4.	Ascorbic acid	84	112	105	110	120	105	112	200	200

The results of the selected nutrients in the Table IV B revealed that, sun dried samples retained more protein and crude fibre, when compared to mushroom dried in solar drier and mushroom dried in hot air oven. The quantity of calcium present in sun dried samples were almost on par with samples dried in solar drier. However it is worthy to note that the quantity of ascorbic acid present in samples dried in hot air oven was more. This may be due to the exposure of mushroom of only for a short time to heat which had retained the ascorbic acid.

From the above table it is understood mushrooms are not a good source of calcium. But the ascorbic acid which oxidises very easily are retained even in dried samples. As the quantity of selected nutrients present in traditional sun drying is more except for ascorbic acid the investigator decided to dry the mushrooms by traditional sun drying in order to proceed further with the study.

B. INFORMATION ON THE KEEPING QUALITY OF THREE VARIETIES OF MUSHROOMS IN FRESH AND DRIED FORMS

Mushrooms are collected from the farms and distributed to the shops. Many a time the shop keeper keep the mushrooms in the refrigerator and sell them as and when there is a demand. Some times the home maker who buy from the shop keepers do not know whether the mushrooms are fresh or spoiled ones. When mushrooms are stored, its quality deteriorates and changes in colour, texture and odour takes place. The regular changes that took place when fresh mushrooms are stored in different conditions, and the time taken for these changes to occur and for them to become unfit for consumption are discussed in Table-V. Plate 2 shows the fresh mushroom and mushrooms on the process of deterioration on the third day.

TABLE V
TIME TAKEN FOR THE PHYSICAL CHANGES TO TAKE PLACE WHILE STORING THE SELECTED
MUSHROOMS

S.No	The Changes of Deterioration	Number of days taken for deterioration					
		Button		Oyster		Milky	
		Room temperature	Refrigerated	Room temperature	Refrigerated	Room temperature	Refrigerated
1.	Change of colour white to light brown	2	3	2	3	5	7
2.	Development of abnoxious odour	2	3	2	3	4	7
3.	Wilting or softening of texture	3	4	2	3	5	7
4.	Shrinkage in size	3	5	3	4	5	7
5.	Flattening of sporocarp	4	4	3	4	6	8

From Table V it is clear that the first physical change noted in selected mushrooms was change of colour. For both button and oyster mushrooms on the next day of its harvest it turned from white to light brown colour(button) and dull white (oyster) when kept at room temperature and it took two days when kept in refrigerator. In the case of milky mushroom it took five days to change the colour when left outside and seven days when left in the refrigerator. Along with the change of colour the mushroom developed an abnoxious odour. At this stage mushrooms are not advised for consumption. When the mushrooms are left further the veils of button mushroom started to open, lengthening of stipe took place and cap wilted on the third day while the oyster and milky mushrooms became soft on the second day and fifth day respectively. The samples left in the refrigerator took one or two days than the samples left outside to reach this stage. Within three to five days the mushrooms started to shrink when left at room temperature. Flattening of the sporocarp (cap) of button and milky mushroom took place on fourth and sixth day of initiation of the experiment, for the sample kept at room temperature and in refrigerator.

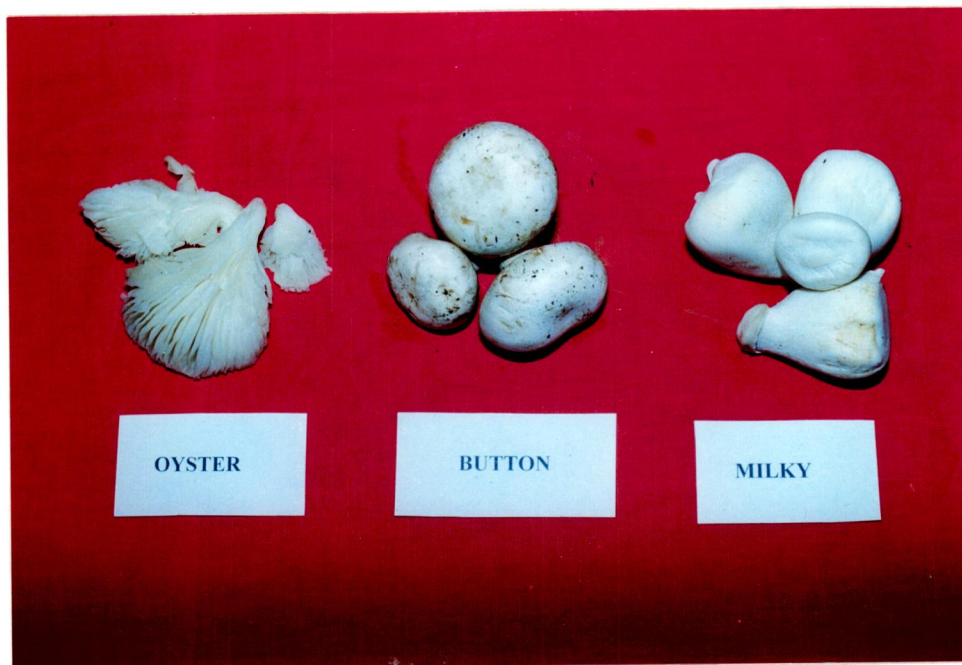
The sporocarp of the oyster mushroom also became flat and started to ooze out starw colour liquid from third day onwards. This is clear from this Table that the milky mushroom has more shelf life when compared to oyster and button even when kept at room temperature. Hence it may be said that milky mushroom is ideal variety to cultivate for growers, for whom the short shelf life is a major constraint in their business.



Fresh Mushroom



Mushrooms kept at room temperature



Mushrooms kept at Refrigerator

Plate 2. Fresh Mushroom and deteriorating mushrooms on third day

In order to find out the shelf life of dried mushrooms 20g of each variety of mushrooms were taken and sealed in a polythene cover and stored in a dry cool place. Even after three months there was no change in the weight or in their physical appearance. Hence it could be concluded that mushrooms can be dried in the sun and can be preserved for longer time. This could be followed by the cultivators and sellers when the mushrooms are not sold due to lack of demand and could be utilised later without much economic loss.

C.THE ACCEPTABILITY OF THE DELICACIES PREPARED USING THE THREE VARIETIES OF MUSHROOMS IN FRESH AND DRIED FORMS

The results of the organoleptic qualities tested by the selected young adults are consolidated and given in Table VI VII, and VIII. Mushrooms are always considered delicious food by all. The mushroom delicacies prepared using three common varieties in fresh and dried forms were evaluated for its taste, texture, flavour and appearance. The scores obtained by the delicacies prepared using fresh mushrooms and dried mushrooms and the percentage of scores obtained by mushroom delicacies are discussed under their aspect. Table V gives information on scores obtained by various delicacies prepared from fresh button, oyster and milky mushrooms.

TABLE VI

SCORES OBTAINED BY VARIOUS DELICACIES PREPARED FROM
FRESH BUTTON, OYSTER AND MILKY MUSHROOMS

S.No	Delicacy	Mushroom variety	Taste	Texture	Flavour	Appearance	Total
1.	Mushroom Fantasy	Button	3	2	2	3	10
		Oyster	2	3	2	2	9
		Milky	3	3	2	3	11
2.	Mushroom Omlette	Button	3	3	3	3	12
		Oyster	3	2	3	3	11
		Milky	3	3	3	3	12
3.	Mushroom Pulao	Button	2	3	2	2	9
		Oyster	2	2	2	2	8
		Milky	2	2	2	3	9
4.	Mushroom Poogath	Button	3	3	3	2	11
		Oyster	2	3	2	2	10
		Milky	3	3	2	3	11
5.	Mushroom Sandwich	Button	3	3	3	3	12
		Oyster	3	3	2	3	11
		Milky	3	2	3	3	11
6.	Mushroom Bonda	Button	3	3	3	3	12
		Oyster	3	3	3	3	12
		Milky	3	3	3	3	12
7.	Mushroom Delights	Button	3	3	3	3	12
		Oyster	2	3	2	3	10
		Milky	3	3	3	3	12
8.	Mushroom Delight	Button	3	3	3	3	12
		Oyster	2	2	2	3	9
		Milky	3	2	2	3	10

* Maximum score for each criterion is 3

For all the selected delicacies, button mushroom scored maximum for its taste, except for mushroom fantasy. For mushroom fantasy, pulao and

poogath it scored maximum for its texture, flavour and appearance.

Oyster mushroom scored maximum for taste of mushroom omlette, sandwich and mushroom bonda for its texture in mushroom fantasy, poogath bonda and soup and for flavour it scored maximum only for mushroom bonda. With regard to its appearance except for mushroom fantasy, pulao and poogath it scored maximum for all other items.

The delicacies prepared using milky mushroom did not score maximum for its taste and texture in pulao, texture in sandwich and delight, flavour in fantasy, pulao, poogath and delight. However all the delicacies prepared using milky mushroom appeared good.

Though dried mushroom are not highly acceptable in India, the attempt made by the investigator to prepare the selected delicacies using the mushroom dried under direct sun revealed that the delicacies were acceptable.

TABLE VII

SCORES OBTAINED BY THE DELICACIES PREPARED WITH
DRIED BUTTON, OYSTER AND MILKY MUSHROOMS

S.No	Delicacy	Mushroom variety	Taste	Texture	Flavour	Appearance	Total
1.	Mushroom Fantasy	Button oyster	2	2	2	2	8
		Milky	1	2	1	2	6
			3	3	2	3	11
2.	Mushroom Omlette	Button	1	2	2	2	7
		Oyster	1	2	1	2	6
		Milky	2	2	2	2	8
3.	Mushroom Pulao	Button	3	2	2	3	10
		Oyster	2	2	1	3	8
		Milky	2	3	2	3	10
4.	Mushroom Poogath	Button	2	2	2	2	8
		Oyster	1	2	1	2	6
		Milky	2	2	1	2	7
5.	Mushroom Sandwich	Button	2	1	2	1	6
		Oyster	2	1	1	1	5
		Milky	2	1	2	1	6
6.	Mushroom Bonda	Button	2	2	2	3	9
		Oyster	2	2	2	3	9
		Milky	2	2	2	3	9
7.	Mushroom Soup	Button	1	2	2	3	8
		Oyster	1	2	1	3	7
		Milky	1	3	2	3	8
8.	Mushroom Delight	Button	2	2	2	2	8
		Oyster	2	1	1	2	6
		Milky	2	2	1	2	7

* Maximum score for each criterion is 3

The Table VII shows the scores obtained by various delicacies prepared using dried forms of button ,oyster and milky mushrooms. From this it is clear that button mushroom received maximum score for taste and

appearance of pulao, appearance of bonda and soup and minimum score for taste of mushroom omlette and soup, texture and appearance of sandwich.

Oyster mushroom was given maximum score for appearance of mushroom bonda and soup alone. It revealed that the flavour of the oyster mushroom is not highly acceptable in any of the preparations except mushroom bonda. Milky mushroom scored maximum for the taste, texture and appearance of mushroom fantasy, texture, and appearance of pulao and soup and texture of bonda and scored minimum for taste of mushroom soup, texture of sandwich, flavour of poogath and delight and appearance of sandwich.

Inorder to compare the scores obtained by the delicacies prepared using fresh and dried form of selected varieties of mushroomsm, percentage of score received by the delicacies were calculated and presented in table VIII, and Figure 3A, 3B, 3C

TABLE VIII

PERCENTAGE OF SCORES OBTAINED BY MUSHROOM
DELICACIES OF FRESH AND DRIED FORM OF SELECTED
VARIETIES

S.NO.	Mushroom Delicacies	Button Mushroom		Oyster mushroom		Milky Mushroom	
		Fresh	Dried	Fresh	Dried	Fresh	Dried
1.	Mushroom Fantasy	83	67	75	50	83	92
2.	Mushroom omlette	100	59	92	58	100	67
3.	Mushroom pulao	75	83	67	67	75	83
4.	Mushroom Poogath	92	67	83	50	92	58
5.	Mushroom Sandwich	100	50	92	42	92	50
6.	Mushroom Bonda	100	75	100	75	100	75
7.	Mushroom Soup	100	67	83	75	100	67
8.	Mushroom Delight	100	67	75	50	83	58
	Average Score	94	67	83	58	91	69

Among the recipes prepared using fresh mushrooms, recipes prepared using button mushroom was found to be highly acceptable (94%) followed by milky mushroom (91%) and oyster mushroom (69%). However when dried forms used for preparing delicacies maximum score of

69 percent was obtained by milky mushroom followed by button (67%) and oyster mushroom (58%). An average difference of 22-27 percentage of score was noted down between the delicacies prepared using fresh and dried mushroom.

Though fresh mushrooms are highly acceptable among the consumers, in places where mushrooms are not available or during off seasons it could be used in dried form.

The result of the test of significance applied for scores obtained by various delicacies using fresh form of selected mushrooms are given in Table IX.

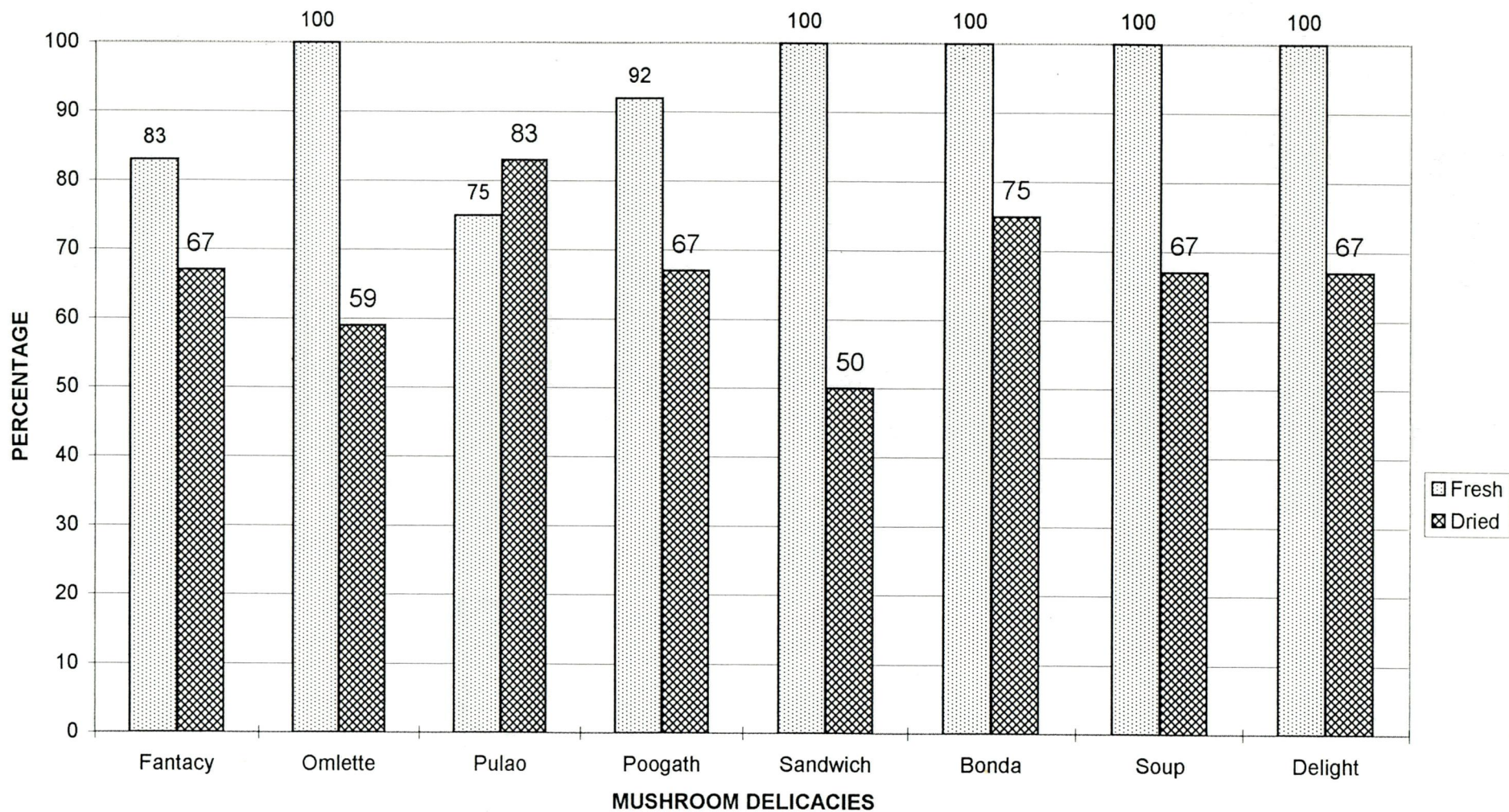


FIGURE 3-A
PERCENTAGE OF SCORES OBTAINED BY MUSHROOM DELICACIES PREPARED WITH FRESH AND DRIED BUTTON MUSHROOM

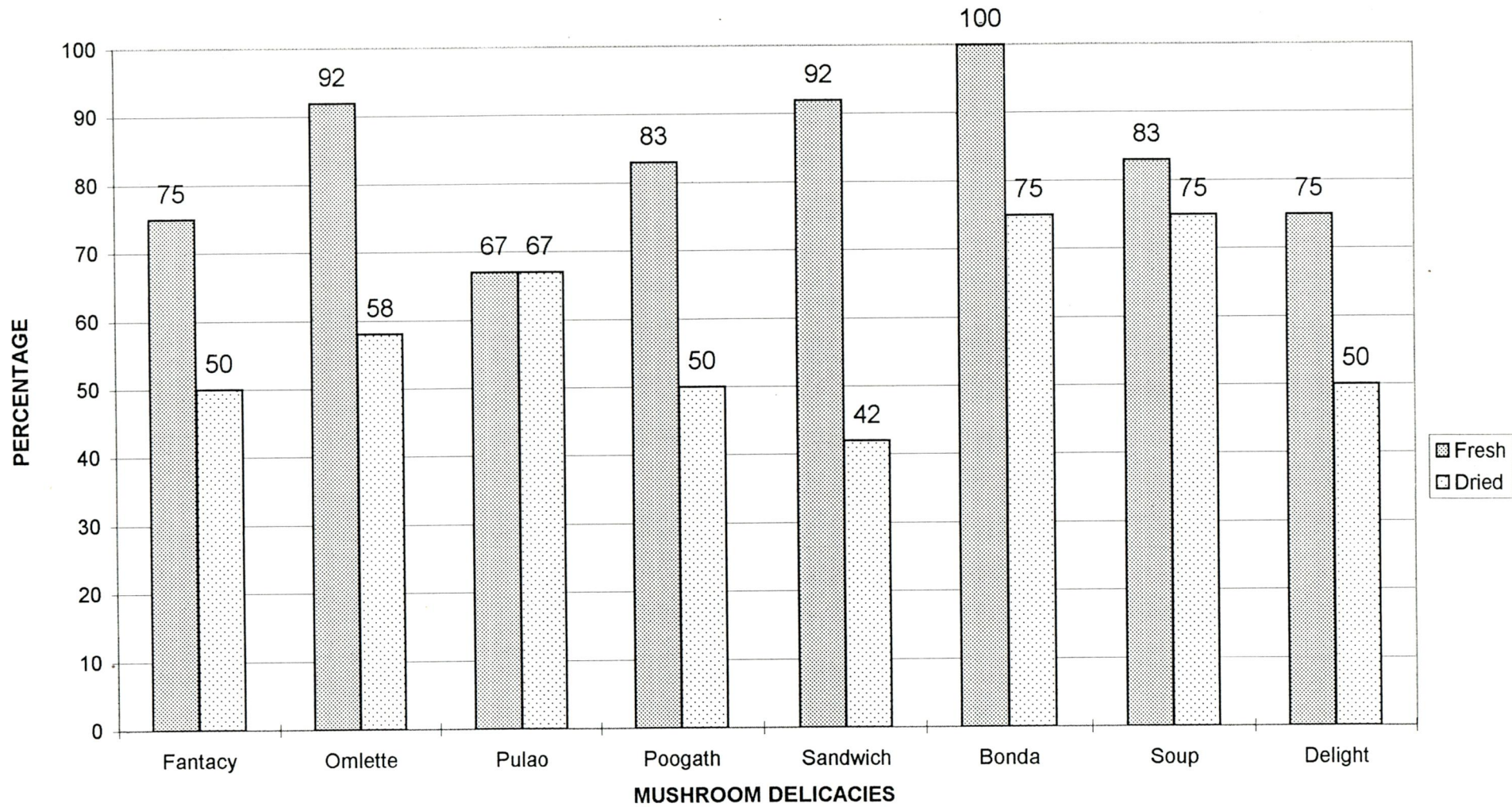


FIGURE 3-B
PERCENTAGE OF SCORES OBTAINED BY MUSHROOM DELICACIES PREPARED WITH FRESH AND DRIED OYSTER MUSHROOM

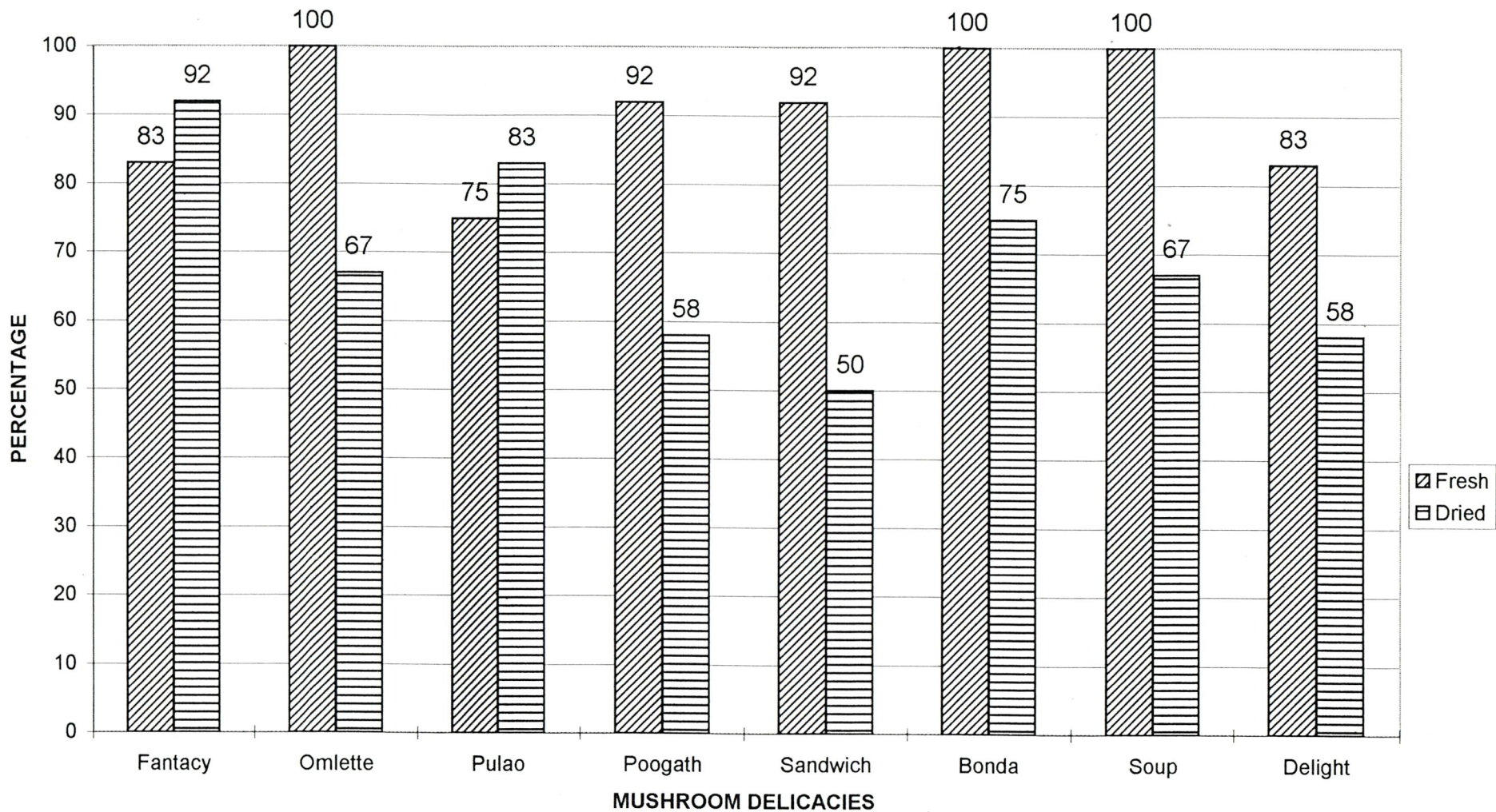


FIGURE 3-C
PERCENTAGE OF SCORES OBTAINED BY MUSHROOM DELICACIES PREPARED WITH FRESH AND DRIED MILKY MUSHROOM

TABLE IX

MEAN \pm SD VALUES OBTAINED FOR VARIOUS DELICACIES
WITH TEST OF SIGNIFICANCE FOR FRESH MUSHROOMS

S.No	Delicacies	Varieties of mushrooms with Mean \pm SD			Variation	t- Value
		Button	Oyster	Milky		
1	Fantasy	11.3 \pm 0.339	9.2 \pm 0.368	10.6 \pm 0.329	B Vs O O Vs M M Vs B	8.76 * 12** 8.076*
2.	Omlette	11. \pm 0.163	10 \pm 0.495	10.8 \pm 0.424	B Vs O O Vs M M Vs B	0.33 NS 4.43* 3.6 NS
3.	Pulao	11.1 \pm 0.573	9.2 \pm 0.33	10.67 \pm 0.377	B Vs O O Vs M M Vs B	5.74* 1.03NS 0.848NS
4.	Poogath	10.43 \pm 0.309	10.5 \pm 0.292	9.5 \pm 0.377	B Vs O O Vs M M Vs B	9.85* 41.3** 10.16**
5.	Sand wich	11 \pm 0.33	10.67 \pm 0.17	11 \pm 0.082	B Vs O O Vs M M Vs B	1.65 NS 3.14NS 0NS
6.	Bonda	11.6 \pm 0.282	11.08 \pm 0	12 \pm 0	B Vs O O Vs M M Vs B	2.61NS 0.92NS 2.01 NS
7.	Soup	11.03 \pm 0.262	10.5 \pm 0.33	10.4 \pm 0.287	B Vs O O Vs M M Vs B	3.75 NS 0.86 NS 7.68*
8.	Delight	9.97 \pm 1.11	8.73 \pm 0.368	10.93 \pm 0.249	B Vs O O Vs M M Vs B	1.6NS 0.086NS 1.25NS

*Significant at 5% level; **Significant at 1% level; NS - Not Significant

The table reveals that significance at $P < 0.01$ level was noted in the scores obtained for oyster Vs milky mushroom used for preparing fantasy and oyster Vs milky mushroom and milky Vs button mushroom

used for preparing poogath. Significance at $P < 0.05$ level was seen in the acceptability of button Vs oyster, and milky Vs button mushroom used for preparing mushroom fantasy, oyster Vs milky mushroom used to prepare omlette, button Vs oyster used to prepared pulao and poogath, milky Vs button in preparing soup. Totally no significance in the acceptability of different mushrooms were noted for sandwich, bonda and delight, prepared using three varieties of mushroom.

Acceptability trials were conducted with different delicacies prepared using dried mushroom. The scores obtained were subjected to test of significance and given in Table X

TABLE X
MEAN + SD VALUES OBTAINED FOR VARIOUS DELICACIES
WITH TEST OF SIGNIFICANCE FOR DRIED MUSHROOMS

S.No	Delicacies	Varieties of mushrooms with Mean + SD			Variation	t- Value
		Button	Oyster	Milky		
1	Fantasy	6.56± 0.368	5 ± 0.432	9.63± 0.235	B Vs O O Vs M M Vs B	9.887* 15.74** 12.35**
2.	Omlette	6.37± 0.385	6.8±0.726	7.17±0.368	B Vs O O Vs M M Vs B	1 NS 0.84NS 10**
3.	Pulao	9.07±0.704	7.4±0.245	9.13±0.524	B Vs O O Vs M M Vs B	3.57* 5.08* 0.180NS
4.	Poogath	6.6±0.624	6.3±0.341	6.63±0.17	B Vs O O Vs M M Vs B	1.369* 0.908* 0.07*
5.	Sand wich	6.3±0.668	5.7±0.51	6.2±0.544	B Vs O O Vs M M Vs B	1.96NS 3.75NS 0.364NS
6.	Bonda	9.56±0.34	9.1±0.41	9.3±0.80	B Vs O O Vs M M Vs B	2.83NS 0.408NS 0.504 NS
7.	Soup	7.8±0.386	6.1±0.589	8.3±0.497	B Vs O O Vs M M Vs B	5.3 * 9.8 * 2.27 NS
8.	Delight	7.2±0.283	6.16±0.573	6.8±0.249	B Vs O O Vs M M Vs B	2.9NS 2.6NS. 1.6NS

*Significant at 5% level; **Significant at 1% level; NS - Not Significant

It was found that there was high significant difference at ($P < 0.1$) level in mushroom fantasy prepared using oyster Vs milky mushroom, and

omelette prepared with milky Vs button mushroom, Significant difference at ($P < 0.05$) level was noticed for acceptability of mushroom fantasy prepared with button Vs oyster, oyster Vs milky for pulao, button Vs oyster and oyster Vs milky for soup. It could be concluded that there is difference in the taste between mushrooms for selected delicacies. While for others the difference was not significant.

Prepared delicacies were calculated for crude fibre, protein, calcium and ascorbic acid. The results of the analysis is given Table XI

TABLE XI
NUTRIENT CONTENT OF PREPARED DELICACIES USING
SELECTED VARIETIES OF MUSHROOM

S.NO	Mushroom variety	Crude fibre (g)	Protein (g)	Calcium (mg)	ascorbic acid (mg)
1.	Mushroom fantasy				
	Fresh Button	0.53	10.5	60.86	11.54
	Fresh oyster	0.4	12.01	60.84	14.34
	Fresh milky	0.30	10.54	61.5	10.14
	Dry Button	4.76	13.15	60.3	46.04
	Dry oyster	4.76	13.53	60.27	60.04
	Dry milky	4.19	12.5	60.93	56.54
2.	Omlette				
	Fresh Button	0.70	17.28	24.06	10.4
	Fresh oyster	0.87	19.9	24.04	13.2
	Fresh milky	0.931	17.05	27.4	9
	Dry Button	9.33	22.7	26.2	87.4
	Dry oyster	9.03	23.02	26.27	115.4
	Dry milky	8.19	20.96	26.27	108.4
3.	Pulao				
	Fresh Button	1.86	13.08	53.56	19.45
	Fresh Oyster	1.77	14.59	53.54	22.25
	Fresh Milky	1.89	13.12	54.2	18.05
	Dry Button	6.09	15.70	53.6	54.45
	Dry Oyster	5.94	16.11	53.6	68.45
	Dry Milky	5.52	15.08	53.6	67.45

4.	Poogath				
	Fresh Button	1.05	9.95	9.0	5.45
	Fresh Oyster	0.97	11.46	8.08	6.85
	Fresh Milky	1.08	9.9	8.74	4.75
	Dry Button	5.28	12.59	8.14	43.95
	Dry Oyster	5.13	12.98	8.14	57.95
	Dry Milky	5.76	11.90	8.14	55.4
5.	Sandwich				
	Fresh Button	0.43	6.08	11.76	6.24
	Fresh Oyster	0.34	7.59	11.74	7.64
	Fresh Milky	0.45	6.12	12.5	5.54
	Dry Button	4.65	8.72	11.8	44.74
	Dry Oyster	4.5	9.11	11.8	50.74
	Dry Milky	4.08	8.08	11.8	55.2
6.	Bonda				
	Fresh Button	0.67	11.38	17.6	8.15
	Fresh Oyster	0.70	12.89	17.04	9.55
	Fresh Milky	0.70	11.42	17.7	7.45
	Dry Button	4.9	14.02	17.1	46.65
	Dry Oyster	4.74	14.41	17.1	60.65
	Dry Milky	4.33	13.38	17.1	57.15
7.	Soup				
	Fresh Button	0.273	7.38	0.56	4
	Fresh Oyster	0.19	8.89	0.54	5.4
	Fresh Milky	0.30	7.42	1.2	3.3
	Dry Button	4.5	10.02	0.7	42.5
	Dry oyster	4.35	10.41	0.77	56.5
	Dry Milky	4.33	9.38	0.77	54
8.	Noodles				
	Fresh Button	0.653	7.26	10.06	8.9
	Fresh Oyster	0.57	8.77	10.04	10.3
	Fresh Milky	0.68	7.30	10.7	8.2
	Dry Button	4.88	18.35	10.8	89.4
	Dry Oyster	4.73	19.1	10.83	117.4
	Dry Milky	4.3	17.04	10.83	110.4

From the table it could be inferred that all the selected nutrient content is more in the recipes prepared using dried mushrooms irrespective of variety when compared to fresh mushroom . Among the selected recipes crude fibre , protein content were maximum in mushroom omlette, calcium was high in mushroom fantasy and ascorbic acid is greater in mushroom noodles. The nutrient content varied with the ingredients included in the recipe.

Mushroom is one of the valuable commodities in modern world. The cost of mushrooms delicacies raising as the number of consumer increasing. Now in market 200g of button, oyster, and milky mushrooms are sold for Rs. 16-18, Rs. 14-16 and Rs. 9-10 rupees respectively. The cost incurred for various recipes prepared using these mushroom are given in table XII.

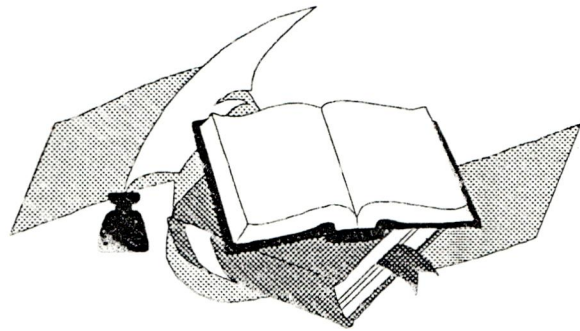
TABLE XII
THE COST INCURRED FOR PREPARING VARIOUS DELICACIES
USING SELECTED VARIETY OF FRESH MUSHROOMS

S.No	Meal	Delicacies	Mushroom variety	cost per plate in Rs.
1.	Break Fast	Mushroom Fantasy	Button	19.00
			Oyster	17.25
			Milky	18.50
2.		Mushroom Omelette	Button	12.00
			Oyster	11.00
			Milky	10.25
3.	Lunch	Mushroom Pulao	Button	14.00
			Oyster	11.75
			Milky	13.50
4.		Mushroom Poogath	Button	6.00
			Oyster	4.75
			Milky	5.56
5.	Tea	Mushroom sandwich	Button	7.75
			Oyster	5.50
			Milky	6.00
6.		Mushroom Bonda	Button	6.00
			Oyster	4.75
			Milky	5.50
7.	Dinner	Mushroom Soup	Button	9.50
			Oyster	7.25
			Milky	9.00
8.		Mushroom Delight	Button	10.50
			Oyster	8.25
			Milky	10.00

Due to the cost variation of the mushrooms, the cost incurred for preparing selected delicacies using different mushrooms also varied. Since

the cost of button mushroom is high followed by milky mushroom and oyster mushroom the trend is also seen on the analysis of cost of the delicacies prepared.

Among the various delicacies the cost per plate of mushroom fantasy was maximum due to the ingredients used in the dish. Minimum cost was noticed for mushroom poogath.



Summary and Conclusion

V SUMMARY AND CONCLUSION

The study "A comparative study on Acceptability, shelf life and selected nutrients of three common varieties of mushroom available in market" aimed to study the following.

1. Drying the three varieties of mushrooms and analyzing its selected nutrient contents
2. Finding out the keeping quality of mushrooms in fresh and dry forms
3. Preparing few delicacies using selected mushrooms in its fresh and dried forms and evaluating its acceptancy and
4. Calculating the nutrient content and cost of the selected delicacies prepared.

The study started with drying the three varieties of fresh mushrooms namely button, oyster and milky mushrooms, which were pretreated with 0.5 per cent potassium metabisulphate solution for 15 minutes. The drying process was done by following three methods namely traditional sun drying, drying in solar drier and hot air oven.

These dried samples were subjected to nutrient analysis for selected nutrients and found out the best method of drying which retains maximum nutrient possible.

The shelf life of button, oyster and milky mushrooms in its fresh forms and dried forms were compared by keeping a sample of each variety at room temperatures and in refrigerator. The dried samples were kept in sealed polythene bags in a dry and cool place for three months.

Using the fresh and dried forms of three varieties of mushrooms, selected delicacies were prepared and the acceptancy was compared among the three, using three point rating scale. Nutrient value of the prepared delicacies in both fresh and dried forms of three varieties of mushroom were calculated along with cost incurred per plate.

A. TIME TAKEN FOR DRYING THE THREE VARIETIES OF MUSHROOMS AND NUTRIENTS CONTENT OF THE DRIED MUSHROOM.

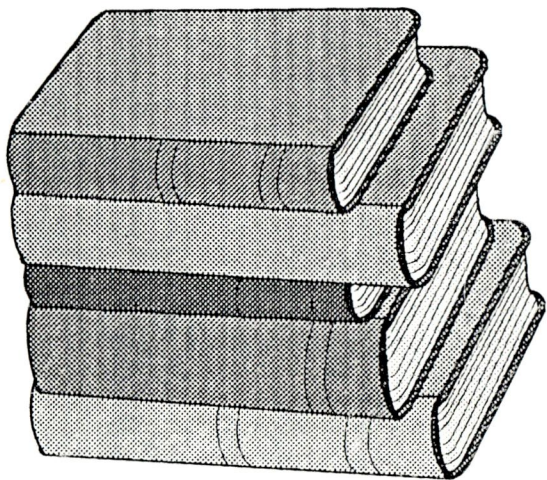
When compared to solar drier and traditional sun drying the time taken for drying, drying in hot air oven was less. Time taken for milky mushroom was more when compared to oyster and button mushroom. The weight of the dried mushrooms is reduced by 89.5 to 90 per cent for almost all the samples. When these dried samples were rehydrated by boiling for 15 minutes the weight regained was 110 per cent for button, 74 percent for oyster and 83 per cent for milky mushroom. When these dried samples were analysed for selected nutrients, the results showed that the protein and fibre loss is less in sun dried samples. Vitamin 'C' was retained even in dry samples. Mushrooms were found to be however poor source of calcium

B INFORMATION ON THE KEEPING QUALITY OF THREE VARIETIES OF MUSHROOM IN FRESH AND DRIED FORM

From the experiment it was inferred that the time taken for

The investigator hope that there is an ample possibility in future the mushroom predominating the table delicacies in future will be milky mushroom.

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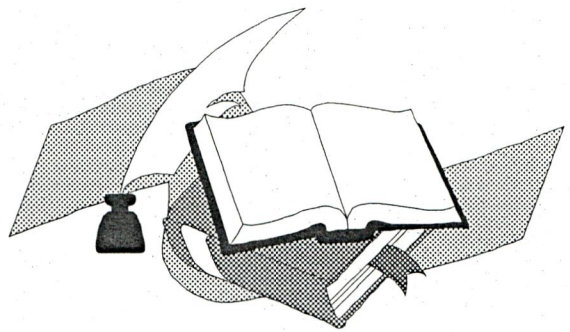
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Appendices

APPENDIX - I

ESTIMATION OF PROTEIN

AIM

To estimate the amount of nitrogen present in 100g of food stuff.

PRINCIPLE

The standard method for the determination of nitrogen is the conversion of nitrogen present in the sample into Ammonium sulphate. By boiling with concentrated sulphuric acid and subsequently decomposing the ammonium sulphate by means of an alkali such as sodium hydroxide ammonia is liberated. The liberated ammonia absorbed by 2 percent boric acid solution and is titrated against N/70 sulphuric acid using a mixed indicator. The protein content is then determined by multiplying the value by 6.25.

PROCEDURE

One gram of the given sample was weighed accurately and transferred into a micro-kjeldhal flask. 20ml of concentrated sulphuric acid was added and a pinch of copper sulphate and potassium sulphate mixture was also added as a catalyst. This was digested until a colourless solution was obtained. In another micro kjeldhal flask only sulphuric acid was taken and digested as before. This was taken as the blank solution. The digested

samples were made up to 100 ml in a standard flask and used for distillation.

Five ml of 2 percent boric acid was pipetted out in a clean conical flask and added 2 drops of mixed indicator. The colour turned pink. The kjeldhal apparatus was washed with distilled water by back suction principle. The conical flask containing the boric acid was kept at the tip of the condenser. 5ml of the black solution was pipetted out into the distillation chamber through the funnel, then added 10 to 15 ml of 40 percent sodium hydroxide into the same. Washed the funnel with little amount of distilled water and close the pinch cork. The steam generator was heated. The steam was generated and heated the mixture in the distillation flask and ammonia was liberated. The liberated ammonia was condensed and collected by the boric acid solution, which changed the colour to blue. The distillation was continued, for 3 minutes after the colour change. Then the blue colour solution was titrated against N/70, sulphuric acid taken in the burette. The end point is the appearance of permanent pale pink colour. Same distillation procedure was repeated for the sample also. The titration were repeated till the concordant value were obtained for the blank and the sample.

RESULT

100gm of food sample contains - gm of protein calculations Blank

Titrated value = ϕ ml

Sample titrated value = - ml

Actual amount of N/70 sulphuric acid needed to neutralise ammonia

$$= \text{titre value} - \phi \text{ ml} = x \text{ ml}$$

1 ml of N/70 sulphuric acid is equivalent to 0.2 m of nitrogen

$$x \text{ ml of N/70 sulphuric acid} = (0.2) \times (x) \text{ mg of nitrogen}$$

$$= Y \text{ mg of nitrogen}$$

$$5 \text{ ml of sample solution contains} = Y \text{ mg of nitrogen}$$

$$100\text{ml of sample solution contains} = (Y) \times 100$$

$$\text{-----} = y1$$

5

$$1\text{gm of food stuff contains} = y1 \text{ mg of nitrogen}$$

$$(Y) \times 100$$

$$\text{Therefore } 100\text{gm of food stuff contains} = \text{-----}$$

1

$$= y2 \text{ mg of nitrogen}$$

$$6.25 \times y2$$

$$1 \text{ mg of nitrogen if equivalent to} = \text{-----} \text{ gm of protein}$$

1000

APPENDIX NO IB

Estimation of Ascorbic acid By Dye Method

Aim: To estimate the amount of ascorbic acid present in the given sample.

Principle

Ascorbic acid is a good reducing agent and it reduce the dye 2,6 dichloro phenol indo phenol. In this reaction. Ascorbic acid itself is oxidised to de hydro ascorbic acid. In the absence of interfering substance, the capacity of an extract of the sample, to reduce a standard solution of the dye as determined by titration is directly proportional to ascorbic acid content. Oxalic acid is not only used to reduce the pH of extracting medium, there by stabilising ascorbic acid, but also to form complexes with metal ions there by preventing the catalytic oxidation of ascorbic acid.

Reagents needed:

1. 2,6 dichlorophenol - indophenol
2. Oxalic acid crystals
3. Standard ascorbic acid
4. Sodium bicarbonate

Preparation of Reagents

2,6-Dichloropheno indophenols:

Weight 42 mg of sodium bicarbonate and 52mg of dichlorophenol indophenol dye powder and dissolved sodium bicarbonate and

dichlorophenol indophenol in 50ml of water. This was diluted to 200ml. Filtered and stored in refrigerator for not more than 3 days.

2. Oxalic acid

Weighed 4 g of oxalic acid and dissolved in 100 ml of distilled water.

Calculation for Dye factor

Pipetted out 10ml of the standard ascorbic acid solution into a conical flask and then added 25ml of oxalic acid. From that 5 ml was pipetted out into a conical flask. The conical flask was placed in an ice container and the contents were titrated against dye in the burette. The end point was the appearance of pink colour which persisted for five seconds. The amount of dye consumed is equivalent to the ascorbic acid present.

Procedure

5gm of the sample was weighed and soaked in oxalic acid for 10 minutes. This was ground in a mortar and transferred into centrifuge tubes and centrifuged and the supernatant clear liquid was transferred to a standard flask (100 ml). This was made up to the mark with oxalic acid. The dye was taken in a burette and titrated against 5ml of extract in a conical flask. The end point is the appearance of permanent pale pink colour. The titration was repeated till concordant was obtained.

Result

The amount of ascorbic acid present in sample is -mg

Calculation

Dye factor = x mg of ascorbic acid

1 ml of the dye is reduced by = x mg of ascorbic acid

Y ml of the dye is reduced by = $X \times Y$
----- = Y_1

5 ml of the extract contains Y_1 mg of ascorbic acid.

$Y_1 \times 5$

Therefore 100ml of the extract contains = ----- mg of ascorbic acid
100

5gm of food sample containing = Y_2 mg of ascorbic acid

Y_2

Therefore 100 gm of food sample contain = ----- x 100
5
= mg of ascorbic acid

APPENDIX IC

Determination of fibre content

Aim

To determine the fibre content of given food sample.

Principle

By the term crude fibre means, in food analysis the combustible residue that is left after the other carbohydrate and proteins have been removed by successive treatments with boiling acids and alkali.

The residue is largely cellulose and consists of carbohydrate not assimilable by humans.

Reagents needed:

0.25 N H₂SO₄ - 0.9 ml of H₂ SO₄, in 99.1 ml of water

0.313 N, NaOH - 0.89 of NaOH in 99.2 ml of water Ether and alcohol.

Procedure

Five gms of the sample was weighed in 500 ml beaker and 200 ml of boiling 0.25 N H₂SO₄ was added. The mixture was boiled for 30 minutes. Keeping the volume constant by adding water at frequent intervals. At the end of the period the mixture was filtered through a muslin cloth and the residue was washed with hot water till free from acids. Then the mixture was transferred into a beaker containing 200ml of boiling was filtered through a muslin cloth. The residue was washed with hot water till free from alkali followed by washing with some alcohol and ether. It was then transferred into a crucible, dried over night at 80-100°C and weighed. The crucible was heated in muffle furnace at 600°C for 2-3 min hrs cooled and weighed again. The difference in the weights represent the weight of the fibre.

Result

The amount of fibre present in the given food sample was found to be _____ gms.

Calculations

Weight of the crucible = (a)

Weight of the crucible + sample of food = (b)

Weight of food sample after heating in muffle furnace = (c)

$$\text{Weight of the fibre in 100g of sample} = \frac{c - a \times 100}{5}$$

$$= x \text{ g}$$

APPENDIX II

SCORE CARD TO SEE THE CHANGES OCCURING WHILE STORAGE

Colour	White	Lightbuff	Light buff with dark patches
Odour	Pleasant	Developing foul smell	Abnoxious
Texture	Rigid	Soft	Wilted
Size	Normal	Start to shrink	Shrunken
Appearance of cap	Convex cap	Slightly Flattened	Flattened cap
Appearance of stipe	Plumpy	Slightly Shrunken	Shrunken

APPENDIX III

Recipes

BREAKFAST ITEMS

Mushroom fantasy

Ingredients:

Mushroom (cut)	50 g
Paneer (crumbled)	25g
Tomato (cut)	10g
Capsicum (cut)	10g
Onion	10g
Pepper to taste	
Salt to taste	
Refined oil	

Method:

Heat oil and fry onion. When half done add the tomatoes and capsicum also and fry. Add the cut mushrooms and fry. Add salt, pepper and crumbled paneer and cook till done.

Mushroom omelette

Ingredients :

Mushroom (cut)	100g
Egg	1
Onion	5 nos
potato (Mashed)	1 small

Milk	3 tsp
Ginger	1/8" piece
Garlic	2 flakes
Green chilli	1
Curry leaves	3 leaf lets
Turmeric	a pinch
Salt to taste	
Pepper powder	¼ tsp
Cooking oil	½ tsp

Method:

Heat oil in a frying pan. Sauté ground garlic ginger paste and curry leaves. To this add pepper powder and turmeric powder and sauté for 1 more minutes. Add mushrooms (finely chopped) green chilli and onion to milk and mix well. Add this mixture to the frying pan when the colour slightly changes add well beaten egg and mashed potato. Scramble the product and serve hot.

LUNCH RECIPES

Mushroom pulao:

Ingredients:

Pulav rice	50g
Beans	15g
Mushrooms	50g
Carrots	15g
Peas	15g
Onion (cut length wise)	20g

Dalda	10g
Ghee	30g
Salt to taste	
For grinding:	
Garlic	4 flakes
Ginger	1" piece
Fennel seeds	1tsp
Onion	20gm
Clove	1
Green chilli	2
Cinnamon	1 piece
For garnishing:	
Cashew nuts	2 pieces
Onion	20grams

Method:

• Roast the rice with 15g of ghee. Then cook the rice with salt. Do not allow the rice to be over cooked. The grains should be separate. Slice beans length wise. Cut carrot length wise or cut into cubes and quarter them. Boil the vegetables. Garnish with fried onion and cashew nut.

Mushroom Poogath:

Ingredients:

Mushroom (finely chopped)	50g
Coconut (Scrapped)	20g
Big onion (1/2 small one)	10g
Garlic	2 flakes

Curry leaves	3 leaflets
Mustard seeds	½ tsp
Cooking oil	½ tsp
Green chilli	1
Turmeric powder	¼ tsp
Salt to taste	

Method:

Grind coarsely coconut, chilli, garlic and turmeric powder heat oil in a frying pan. Add mustard seeds, chopped onion and curry leaves. When onions turns brown, add the ground ingredients. Fry for 2 - 3 minutes. Then add finely chopped mushroom and mix. Add little water. Cover and cook until it is cooked. Remove from fire.

TEA TIME RECIPES

Sandwich filling

Ingredients:

Mushrooms	50gm
Onion	25gm
Green chilli	1 no
Pepper	1/8 tap powdered
Turmeric powder	a pinch
soya sauce	½ tsp.
Oil	1 tsp

Method:

Heat oil in a pan. Add the shreaded onion, chopped green chilli and sauté for a few minutes. Add the chopped mushrooms, turmeric powder,

pepper and salt and cook for 10 minutes. Add soya sauce, remove from fire.

Mushroom Bonda

Ingredients:

Mushroom (Chopped)	50g
Potato (boiled and mashed)	25g
Onion (big)	1
Clove	1
Green chilli	1 no.
Cinnamon	1/8 piece
Basen	25g
Turmeric powder	1 pinch
Ginger	1/8 piece
Curry leaves -few leaf lets	
Oil for frying.	

Method :

Heat little oil. Saute onion, green chillies, ginger and curry leaves. Add chopped mushrooms, masala powder (ground clove and cinnamon), turmeric, salt and continue sauteeing for 5 minutes. Add mashed potato to this mixture a thick solution of basen. Dip the balls into this solution and deep fry in hot oil. Serve hot.

DINNER RECIPES

Mushroom soup

Ingredients:

Mushrooms (finely chopped)	50g
----------------------------	-----

Big onion (finely chopped)	¼ of a small one
Butter	1 tb spoon
Water	1 ¼ cup
Pepper powder to taste	
Milk	½ cup
Corn flower	1/4 tsp
Salt to taste	
Celery (Chopped)	1 stem

Method:

Heat ½ tb spoon butter in a frying pan. Add finely chopped mushrooms and onions and add ¼ cup water. Grind this mixture well in a mixer. Heat ½ tb. Spoon of butter and corn flour. When it is warm add hot milk and stir continuously without any lumps. Continue stirring until the mixture is thick. Add the mushroom onion mixture in this and continue to stir. When the soup is thick add salt and pepper and chopped celery.

For garnishing:

Take an egg, make a small hole (1/4 cm in diameter) on the white of the egg into the boiling soup stir the soup with a fork continuously. The egg white should have a thread like appearance on coagulation.

Mushroom-Noodle delight

Ingredients:

Noodles	50 g
Capsicum	20 g
Mushroom	30 g

French beans 20 g
 Soya sauce 1 tb sp
 Salt and pepper to taste
 Oil 30 g

Method:

Boil the method in water. When it is cooked drain the noodles and rinse in cold running water. Sauté beans, capsicum, mushroom and onion in a frying pan. Add salt and pepper and sauté well. Heat 1 tb. Sp of oil and fry the noodles and add the sautéed vegetables. Cook in flame for 1 minutes. Add 1 tb. sp of soya sauce serve hot.

APPENDIX - IV

SCORE CARD FOR RECIPES

	I			II			III		
	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Taste									
Texture									
Flavour									
Appearance									