EMPOWERMENT OF MUSHROOM GROWERS THROUGH TECHNOLOGY TRANSFER OF VALUE ADDED PRODUCTS

by

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(2012 – 16 – 109)

THESIS

Submitted in partial fulfilment of the
requirements for the degree of

MASTER OF SCIENCE IN HOME SCIENCE
(Food Science and Nutrition)

Faculty of Agriculture
Kerala Agricultural University

DEPARTMENT OF HOME SCIENCE
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VELLAYANI, THIRUVANANTHAPURAM – 695 522
KERALA, INDIA

2015

DECLARATION

I hereby declare that this thesis entitled **"EMPOWERMENT OF MUSHROOM GROWERS THROUGH TECHNOLOGY TRANSFER OF VALUE ADDED PRODUCTS"** is a bonafide record of research done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CERTIFICATE

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ACKNOWLEDGEMENT

I am grateful to "Almighty god" who provided me the strength to fulfil the task in a satisfactory manner. I am indebted for numberless blessings that the god showers upon my life.

Let me place on record of my profound feeling of gratitude and sincere thanks to my chairperson of the advisory committee, ***Dr. Soffi Cheriyan****, Associate Professor (Rtd.), Department of Home Science for her valuable and affectionate guidance, constant encouragement and unfailing patience throughout the course of this research work and in the preparation of thesis.*

I extent my sincere gratitude to ***Dr. Mary Ukkuru. P,*** *Professor and Head, Department of Home Science, for her valuable suggestions, ever willing help and constant criticism which had been rendered whole heartedly throughout my research work.*

My heartfelt thanks to ***Dr. B. Prasanna Kumari,*** *Associate Professor, Department of Home Science for her whole hearted cooperation, constructive criticism and valuable assistance during the course of study & period of investigation.*

I wish to express my gracious thanks to ***Dr. D. Geetha****, Professor, Department of Plant Pathology, for her immense help, constructive suggestions & co-operation rendered throughout the course of research endeavour.*

I greatly acknowledge the patron of College of Agriculture, the Dean for providing me all necessary facilities from the university during the whole course of the study.

I am truly and deeply grateful to other teachers of the department, ***Nandini teacher, Suma teacher, Nirmala teacher*** *and* ***Rari teacher*** *for their valuable help*

and encouragement rendered during the study period and also thankful to ***non teaching staff*** *of the department.*

I obliged to ***Dr.Vijayaraghava Kumar,*** *Professor and Head, department of statistics for executing the statistical analysis of the data.*

I also wish to record my gratitude to all my respondents for their whole hearted cooperation which helped in the generation of the data.

I sincerely thank the facilities rendered by the Library of College of Agriculture, Vellayani.

From the depth of my heart I thank ***Mariyam, Stephy*** *and* ***Krishnasree chechi*** *for their continuous support and love. They have helped me stay same through these difficult years. I greatly valued their friendship. Their support and care helped me overcome setbacks and stay focused on my study.*

My sincere thanks to my dearest friends ***Anila, Rashmi, Liji*** *and* ***Raichel*** *for their indispensible help, love, moral support and constant encouragement. My loving thanks to my seniors and juniors* ***Anju chechi, Midhila chechi, Krishnaja chechi, Poornima chechi, Suma, Veena, Siji, Priya, Ashwathy and Ambika*** *for their love and support. Special thanks for* ***Krishnendu chechi*** *for her loving and caring support and also constant encouragement throughout my research work.*

Most importantly, none of this would have been possible without the love and patience of my family. Words cannot express my love and gratitude to my ***Vappa, Umma*** *and* ***Suni*** *for all of the sacrifices that you have made for me. Your prayers for me was what sustained me thus far. And especially thanks to all my cousins and relatives. The love, support and encouragement given by them was a real source of inspiration.*

I thank all those who extended help and support to me during my thesis work.

Saima Usman

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LIST OF ABBREVATIONS

%	-	per cent
°C	-	Degree Celsius
BOD	-	Biochemical Oxygen Demand
cfu/g	-	colony forming units per gram
CVD	-	Cardiovascular diseases
EAA	-	Essential amino aids
eg	-	example
et al.	-	and others
etc.	-	extra
FAO	-	Food and Agricultural Organisation
gm	-	gram
HIV	-	Human Immuno deficiency Virus
hrs	-	hours
i.e.,	-	that is
Kg	-	kilogram
KMS	-	Potassium Metabisulphite
min	-	minutes
ml	-	milli litre
NAAS	-	National Academy of Agricultural Science
NRCM	-	National Research Centre for Mushroom
PPO	-	Poly Phenol Oxidase
Rs	-	Rupees
SHG	-	Self Help Group
USDA	-	United State Department of Agriculture

Introduction

1. INTRODUCTION

Production and consumption of mushroom has tremendously increased mainly due to the increased awareness of commercial and nutritional significance of this commodity. India too, though a late starter is fast catching up and the current production has crossed lakh tonne mark with annual growth rate of above 15 per cent. Now mushroom cultivation is emerging as an important activity in different parts of our country. In the last ten years, large numbers of commercial units have been built by the entrepreneurs or farmers throughout the country for the production of mushroom. This intensive type of mushroom cultivation has provided good job opportunities for the small family enterprises mainly through the means of value addition. Kumar and Rai (2007) reported that mushrooms are gaining immense popularity and the consumers demand for variety has led to the development of readymade or value added processed food from mushrooms. Current era is also characterized by greater awareness about quality and with the demand for the ready-made or ready to make food products.

Mushrooms are living entities and are affected by a number of factors leading to post harvest spoilage and losses. Mushrooms contain about 91 per cent of moisture, are highly perishable and cannot be stored for more than 24 hours at ambient temperature. Once the fruiting body matures and is harvested, degradation process starts and it became non consumable after some time, if not properly handled.

Fresh mushroom market is catered by small scale growers who do not have cold storage facilities and sell their produce at highly localized markets. Needless to mention such growers often face consequences of weight loss, browning, wilting and finally spoilage. Damaging post-harvest changes in mushroom affect their marketability significantly this often results in enormous economic loss to growers. Proper sound and appropriate post-harvest practices of storage and processing are needed to sustain the budding mushroom farming and to keep the wheels of this

industry moving. Hence the fresh mushrooms have to be processed to extend their shelf life which in turn helps in the income generation of the growers. Information about proper post-harvest care and processing of such perishable commodity is therefore of vital importance.

The retention of fresh mushroom at the level of grower, wholesaler, retailer or consumer may result in deterioration in the quality of the produce rendering high per cent economic loss. Thus gluts in the market can be checked by adopting appropriate post-harvest technology by processing surplus mushrooms in the form of novel value added products.

Adoption of proper post-harvest practices of processing may partially ameliorate the problem of marketing mushroom during peak periods (Rai and Arumuganathan, 2008). According to Chaliha (2007), mushroom being highly perishable, development of appropriate storage and processing technology is of great significance in order to extend the marketability and availability of mushrooms.

The value added products are the need of the hour for the mushroom growers not only to reduce the post-harvest losses but also enhance the additional income by value addition and provide neutraceutical low fat, protein rich food to the consumers. It is also capable of fetching highest price in Indian and international market. The value added products can be sold in local markets for additional family income or exported for an important source of foreign exchange that will definitely improve the economic standards of people.

Mushroom production and value addition being an indoor activity and high profit venture provides ample opportunities for gainful employment of small farmers, landless labourers, women and unemployed youth. Therefore promotion of mushroom value addition will be a step to meet nutritional needs, to reduce malnutrition and providing livelihood to landless poor. According to Alom and Bari (2010), through mushroom cultivation and value addition it is possible to generate

considerable employment opportunity, enhance the family income, alleviate poverty and reduce malnutrition. Entrepreneurship skills can help in building confidence and self awareness through income generation (NAAS, 2001). It is also reported that there is need to design programmes which could gainfully utilize the service and skills of rural folk in relation to their involvement in agribased allied activities.

In the above context, the study "Empowerment of mushroom growers through technology transfer of value added mushroom products" has been planned to develop five innovative value added mushroom products and also to conduct a training programme on technical know-how of selected value added mushroom products among twenty five prospective mushroom growers thus this study has been attempted with the following objectives.

1) Standardization of processed mushroom products and to empower the mushroom growers through technology transfer of these value added products.
2) Assessment of the impact of technology transfer on the profitable utilization of mushroom.

Review of Literature

2. REVIEW OF LITERATURE

Literature available on different aspects related to the present study entitled "Empowerment of mushroom growers through technology transfer of value added products" is reviewed under following headings.

2.1. Nutritional profile of mushrooms

2.2. Therapeutic effects of mushrooms

2.3. Production and cultivation of mushrooms

2.4. Post harvest changes in mushrooms

2.5. Value addition and its importance

2.6. Empowerment through value addition

2.1. NUTRITIONAL PROFILE OF MUSHROOMS

Mushrooms represent one of the world's greatest untapped resources of nutritious food (Obodai *et al*., 2003). Stamets (2000) reported that the use of mushrooms as food is probably as old as civilization and mushrooms currently have greater importance in the diet of mankind.

Earlier it was believed that mushrooms are devoid of nutrients but now researchers have proved mushrooms as a nutritionally sound food of great value and can be considered as meat for vegetarians (Ranote *et al*., 2007). Apart from being tasty, edible mushrooms are cheap sources of high quality proteins, vitamins, minerals, fibres, antioxidants and water and several growth promoting substances and also add flavour to the vegetarian diet (Nita, 2009).

Many species are high in dietary fibre, protein and vitamins such as thiamine, riboflavin, niacin, biotin, cobalamines and ascorbic acid. Mushrooms are also a source of some minerals, including selenium, potassium and phosphorous (http: // www.msnb.msn.com).

Mushrooms fall between high grade vegetables and low grade meats and provide about 35 calories/100gm (Singh *et al*., 2001). Adejumo and Awosanya (2005) reported that energy value of mushroom varies according to species, which is about equal to that of an apple.

High protein content makes them an ideal food because they contain all the essential amino acids and are especially rich in lysine & leucine which are lacking in most staple cereal foods (Sadler, 2003). *Agaricus bisporus* has high EAA content, comparable to that of whole egg.

Carbohydrates are in the form of glycogen, chitin & hemi cellulose instead of starch as in plants (Beelan *et al*., 2004). Among sugars, trehalose which is called the mushroom sugar and sugar alcohol i.e., mannitol play a key role in fruit body formation. Beelman (1987) reported that fresh mushrooms contain about 0.9% of Mannitol & Hemicellulose, 0.28% reducing sugar and 0.59% glycogen.

Oyster mushroom contains as much fiber as one medium tomato and 100g dried mushroom contains 26g of fiber (Shelly *et al*., 2008). Fiber content in *Pleurotus* species ranged between 0.7 and 1.3 per cent on fresh weight basis (Turner, 1993).

Mushroom is a low fat food, containing 1-2% fat on dry weight basis. Mushrooms contain all the classes of lipids including free fatty acids, glycerides, sterols and phospholipids (Kumari and Murthy, 2002). It is clear that 72% of the total fatty acids in mushrooms are unsaturated. The high unsaturation is due to the presence of linolenic acid and it does not contain cholesterol at all (Chang and Mshigeni, 2001).

The fruit body of mushrooms is an excellent source of B - complex vitamins including riboflavin, niacin, pantothenic acid, thiamine, biotin, folate and vitamin B12. Folic acid and vitamin B12 which are absent in most vegetables are present in mushrooms (Cheung, 2011).

Mushrooms also contain vitamin C which ranges from 7-8mg/100g on fresh weight basis. Among different edible species available *L. edodes* contain the highest amount of vitamin C (Crisan and Sands, 1998).

Holick (2007) states that mushroom is the only non - animal natural source of vitamin D. Researchers showed that artificial UV light technologies were equally effective for vitamin D production as in mushrooms exposed to natural sunlight (Koyyalamudi *et al*., 2009).

Oyster mushrooms contain most of the mineral salts required by the human body (Stephanie, 2002). Mushrooms contain several key minerals including copper, potassium, niacin and folate (Marion, 2006). Most people may think bananas are the high potassium foods, but mushrooms out rank bananas on the potassium chart (Manzi *et al*., 1999).

The highest amount of iron is in mushrooms, Morel - raw which contains 12-18mg of iron per 100g. The highest amount of zinc is in mushrooms, Shitake - dried which contains 7.66mg of zinc per 100g (www.diet and fitnesstoday.com/-).

Edible mushrooms contain higher amount of heavy metals than plants (Demirbas, 2000). Many mushroom species are known to contain heavy metals such as cadmium, lead or mercury. From the point of view of Svoboda *et al*. (2002), the heavy accumulation of cadmium, lead or mercury in some edible mushrooms is of great concern in human health.

2.2. THERAPEUTIC EFFECTS OF MUSHROOM

Out of approximately 14000 known species of mushroom, 2000 are safe for human consumption and about 650 of them possess medicinal properties (Rai *et al*., 2007).

Mushrooms have a big potential for the prevention or cure of diabetes more than any other plant species (Pathirage & Yunman, 2011). Mushroom has a glycemic index value close to zero. In other words eating mushrooms will not increase the blood glucose levels.

Researchers at the University of Western Sydney found that mushrooms helped lower blood cholesterol and blood glucose in laboratory animals, possibly due to the fibre present in mushrooms (Jeong *et al*., 2010).

The major cardiovascular benefits of mushrooms are cholesterol reduction, protection against CVD like atherosclerosis, and it reduces the chronic oxidative stress in our cardiovascular system (Sasidharan *et al*., 2010).

Another study by Gunde and Cimerman (1999) states that the addition of 4% dried *Pleurotus* to a high cholesterol diet reduced cholesterol accumulation in the serum & liver of the experimental rats effectively.

Antitumour activity is the most significant therapeutic interest associated with mushrooms. Fruiting bodies of medicinal mushrooms contains polysacharides, triterpenoids, adenosine, germanium and protein found to have antitumour and immuno - modulating effect (Singh *et al*., 2009).

According to Yoshioka *et al*. (2000), the water soluble polysaccharides of mushrooms exhibit anti-tumour activities. Recent studies have compared hot water extract of *Phellinus* with other anti-cancer mushrooms. The *Phellinus* extract showed the strongest evidence of tumour proliferation suppression (Mizuno, 1991).

Another study conducted by the University of Western Australia showed that women who ate an average of only 10g of mushrooms a day had a 65% lower risk of breast cancer (Zhang *et al*., 2009).

Mushrooms are immune stimulants and fight infections by initiating an immune response that results in high levels of white blood cells, cytokines, antibodies and complete protein. *Lentinula edodes* mycelium extracts has been shown to have a direct effect on HIV, helping to inhibit HIV infection by inhibiting the virus's ability to replicate (Bamulabire, 2011).

Yoon *et al*. (2004) reported that in an eight month study on Alzheimer's disease, patients taking a reishi mycelium product demonstrated significant

improvement. Reishi mushrooms are also prescribed in China for a number of psychiatric and neurological afflictions including diseases involving the muscles, anorexia.

P. Ostreatus, P. Sajor - Caju and *P. Florida* protect lipid peroxidation in hepatic tissue in hyper cholestrolemic condition. The hepatoprotective activity of *pleurotus* mushroom is thought to be mainly due to their antioxidant potential (Preeti *et al*., 2012).

A polysacharide fraction from shitake mushroom demonstrated liver protection in animals as well as the ability to improve liver function and enhance the production of antibodies to hepatitis B (Kues & Liu, 2000).

Several mushrooms have anti-allergic and anti-inflammatory activity. Studies show that *Ganoderma* extract significantly inhibited all four types of allergic reactions, including positive effects against asthma and contact dermatitis and is effectively used in treating stiff necks, shoulders, conjunctivitis, bronchitis, rheumatism without any significant side effects. Whole extracts of *Ganoderma* species inhibit the growth of micro organisms responsible for skin problems (Fan *et al*., 2006).

In Chinese chemical studies, more than 2000 patients with chronic bronchitis were treated with *Ganoderma* within two weeks, 60 - 90% patients showed significant improvement with older patients & those with asthma benefiting most (Babal, 2011).

2.3. PRODUCTION AND CULTIVATION OF MUSHROOMS

Mushrooms are being cultivated in more than 100 countries of the world with an estimated total production of over 12 million tons (Kamal *et al*., 2009). Mushroom production is an eco-friendly activity where agricultural or industrial wastes are utilised and recycled. During the last four decades, mushrooms have attained the status of commercial crop (Ramkumar *et al*., 2011).

China alone is reported to grow more than 20 different types of mushrooms in commercial scale and mushroom cultivation has become China's sixth largest industry (Singh and Subrata, 2010).

India is blessed with varied agro climate, abundance of agricultural wastes and manpower making it most suitable for the cultivation of all types of temperate, subtropical and tropical mushrooms (FAO, 1996).

Production and consumption of mushrooms have tremendously increased in India mainly due to increase in awareness of the commercial value and nutritional significance of this commodity. At present, production of mushrooms has crossed lakh tone with annual growth rate of above 15% (Sharma and Dhar, 2010). In India, white button mushroom still contributes more than 85% of the total mushroom production, though its share is below 40% in the global trade. India contributes about 3% of the total world button mushroom production (Prakasam, 2012).

Major mushroom growing states in India are Punjab, Madhya Pradesh, Maharashtra, Himachal Pradesh, Goa, Tamil Nadu and Kerala (Indian Agriculture, 2003).

The state of Haryana ranks third in producing mushroom which has produced 6164 tonnes of mushrooms during the 2007 and it has set a target of producing 7000 tonnes of mushroom for 2008 (www.freshplaza.com).

Verma (1999) stated that Punjab alone produces 20-25% mushrooms out of total production in India. According to a report in Indian Agriculture (2003), India exported 11,797.63 metric tonnes of mushrooms valued at rupees 5,105.30 lakh in 2003.

Lindequist *et al*. (2005) reported that more than 2000 species of mushrooms exist in nature; however less than 25 species are widely accepted as food and only a few have attained commercial importance. Though 20 genera of mushrooms are being cultivated throughout the world only four types viz, Button mushroom

(*Agaricus bisporus*), Oyster mushroom (*Pleurotus spp*), Milky mushroom (*Calocybe indica*) and Paddy straw mushroom (*Volvariella volvacea*) are grown commercially in India (Rai *et al*., 2003).

According to Vyas (1999), mushroom can be cultivated in-doors and does not need large space.

2.4. POST HARVEST CHANGES IN MUSHROOM

Mushrooms have a short postharvest shelf life compared to most vegetables, due to a very high metabolic activity and high water content, making them prone to microbial spoilage and to exhibit enzymatic browning. After harvest the mushroom colour gradually changes from white to brown, due to the appearance of browning and possibly bacterial blotching, while the growth of the stipe and the cap continues. The cap growth results in gradual opening of the mushroom cap (Aguirre *et al*., 2009).

According to Rai and Arumuganathan (2008), post-harvest losses are very high in most of the horticultural commodities and it may be one of the highest in mushrooms. Almost all the mushrooms have very short shelf-life but the paddy straw mushroom has the shortest (few hours at the ambient).

Most damaging post harvest changes in mushrooms vary with species - it is blackening in the button mushroom, cap-opening in the paddy straw mushroom and mucilage in the oyster mushroom, which affect their marketability significantly (Beelman, 1987).

There are several indicators that determine the quality of mushrooms, such as visual appearance, size, colour, maturity stage, development stage, microbial growth and weight loss (Aguirre *et al*., 2008).

Fresh mushroom is highly perishable and deteriorates immediately after harvest (Kumar *et al*., 2014). Presence of more than 90% moisture content of mushrooms indicate that, they are highly perishable and start deteriorating immediately after harvest (Mehta *et al*., 2011).

Mushrooms have very short shelf life – these cannot be stored or transported for more than 24 hours at the ambient conditions prevailing in most parts of year and the country (Kaushal and Sharma, 1995).

Browning, veil-opening, weight-loss and microbial spoilage are the most common postharvest changes in the mushrooms which often result into enormous economic losses (Rai and Arumuganathan, 2008).

The main processes which contribute to loss in mushroom quality after harvest are (i) discoloration, (ii) browning, (iii) loss of closeness, (iv) weight loss and (v) texture changes (Aguirre *et al*., 2009).

Browning

An important cause of loss of mushroom quality during postharvest storage is browning (Ares *et al*., 2006; Parentelli *et al*., 2007). Mushrooms have a short postharvest shelf life compared to most vegetables due to a very high metabolic activity and high water content, making them prone to microbial spoilage and to exhibit enzymatic browning (Mehta *et al*., 2011).

Mushroom browning occurs as a result of two distinct mechanisms of phenol oxidation: (a) activation of tyrosinase, an enzyme belonging to the polyphenoloxidase (PPO) family; (b) and/or spontaneous oxidation (Nerya *et al*., 2006).

Enzymatic browning is a consequence of PPO catalyzed oxidation of phenolic substrates into quinones, which undergo further reactions to dark pigments called melanin. The major PPO enzyme responsible for browning in mushrooms appears to be tyrosinase (Jiang *et al*., 2011).

The activity of tyrosinase, responsible for mushroom browning was dependent on O2 concentration (Antmann *et al*., 2008). According to Saboury (2009), PPOs also known as tyrosinase, catechol oxidase, catecholase, phenolase, monophenol oxidase, and cresolase were first discovered in 1856 in mushrooms. Tyrosinase oxidizes some monophenols to o-diphenols and then the former are

oxidized to quinines, which spontaneously polymerize to form brown, black or red pigments (Nerya *et al*., 2006).

The main processes responsible for mushrooms sensory quality loss are browning and texture changes (Ares *et al*., 2006). The intact mushrooms lose their commercial value within a few days, due to senescence, water loss, microbial attack and browning (Nerya *et al*., 2006).

Weight loss

Weight loss is a very serious problem in all the mushrooms as these contain very high moisture (85-90 %) and are not protected by the conventional cuticle (Dhar, 1992).

Respiration rate

Mushrooms continue to respire after harvest and they have a relatively high respiration rate compared to other fresh produce, the respiration rate of oyster mushroom being three times greater than most fruits. Respiration rate is a good indicator of storage life and respiration results in changes in mushroom texture (Byung, 2004).

Short shelf-life of mushrooms is due to their high respiration rate, tendency to turn brown and lack of physical protection to avoid water loss or microbial attack and which is the major cause of quality losses that accounts for reduction in market value (Mohapatra *et al*., 2010). Therefore, mushrooms need special attention to retain freshness (Kim *et al*., 2006).

The shorter shelf life of mushrooms is due to its very high respiration rate-of about 28.2-43.6 mg CO_2 per kg fresh weight per hour at 0°C (Hammond and Nichols, 1975) and 280 mg CO_2 per kg fresh weight per hour at 19°C (Rai and Arumuganathan, 2008).

Respiration is widely assumed to be slowed down by decreasing available O_2 and increasing CO_2. Shitake mushrooms showed a higher respiration rate and

a higher susceptibility to high CO_2 concentration than other mushrooms varieties (Ares *et al.,* 2006).

Texture changes

One of the main changes associated with mushrooms deterioration are changes in their texture (Ares *et al*., 2006; Parentelli *et al*., 2007). Mushroom texture can be affected by various factors like heat treatment and storage in pH ranges and showed that shear force exhibited similar trend to firmness but with distinguishable differences (Caglarirmak, 2007).

Loss of texture, development of off flavour and discolouration results in poor marketable quality and restricts trade of fresh mushrooms (Sharma and Dhar, 2010).

2.5. VALUE ADDITION IN MUSHROOMS AND ITS IMPORTANCE

According to Saima *et al.* (2014), value addition is a process of increasing the economic value and consumer appeal of a commodity. It is a production/ marketing strategy driven by consumer needs & preferences produce is changed from its original form to a more desirable form. The primary reason for processing is to extend the shelf life beyond the period when there is plenty in to the bend or away of season period.

As per the USDA (2010) definition value added agriculture products are characterised by one or more of the following criteria :

1) A change in the physical state/ form of the product.

2) The production of a product in a manner that enhances its value, as demonstrated through a business plan.

3) The physical segregation of a commodity or product in a manner that results in the enhancement of the value of the commodity.

According to Nirmal *et al.* (1999), value added products are raw or pre processed commodities whose value has been increased through the additional ingredients or processes that make the product more attractive to the buyer or more valuable by the consumer. Value added processing of agricultural commodities makes an important contribution to agricultural development and farm income of the country.

Foods are perishable commodities and are therefore processed to preserve them from deterioration while providing the consumer with palatable, wholesome, nutritious and tasty food in convenient from throughout the year (Anand, 2000).

According to Mallaya (2003), food processing is very important for the prosperity of India. Food processing industry helps to avoid post harvest loses of agricultural products in India. Value addition of the food production is only 7% in India compared to 23% in China, 45% in Philippines though we have gone a long way in improving our food production.

Rai and Athwali (2000) reported that more and more people are going for processed foods and it is estimated that over 10% of total expenditure incurred in the household for foods is spend on processed foods.

Kaur and Kapoor (2002) are of the opinion that fresh foods which are in excess supply during season and storage during the rest of the year is a phenomenon which invites attention to the development of technologies for appropriate processing and packaging.

Mushrooms are gaining immense popularity and the consumers demand for variety has led to the development of readymade or value added processed foods from mushrooms (Kumar and Rai, 2007).

NAAS (2006) stated that increased productivity demands proper post harvest infrastructure to increase shelf life and marketability. The consumption of mushroom throughout the year, particularly of species harvested in nature habitats

is made possible through the use of appropriate processing and value addition (Czapski, 2002).

In India, the mushroom market is largely the contribution of small and marginal farmers with limited resources, who are dependent on local markets for the sale of their produce (Wakchaure *et al*., 2010). Progressive Farmer (2000) stated that there is going to be good demand for processed and value added foods and serious thoughts has to be given to bring product diversification and mushroom processing in order to compete in the international market.

In view of their high perishable nature, the fresh mushrooms have to be processed to extend their shelf life for off season use. This can be achieved by adopting appropriate post-harvest technology to process surplus mushrooms into novel value added products. The value-added products are the need of the hour for the mushroom growers not only to reduce the losses but also to enhance the income by value-addition and boost the consumption of this important horticultural crop (Gopinath *et al*., 2013).

Cook (1975) states that high perishability of fruits and vegetables lead to a high degree of wastage. Sethi (1993) pointed out that in spite of high production of fruits and vegetables, 20 - 30% of the produce are not utilised due to post harvest problems.

Suslow and Cantwell (1998) postulates that the highly perishable nature of fresh mushrooms is the limiting factor for mushroom marketing. Quality deterioration starts just after harvesting. Therefore, producers are not able to hold it fresh for more days to market. Processing into value added products is one option producers can adopt to save the product from spoilage.

Huge variety of underutilised fruits and vegetables available are not easily marketed in the fresh form hence should be processed into value added products. So that the consumers all over the world get an opportunity to enjoy the fruit and vegetables at least in processed form (Roy, 2001).

According to FAO (2004), because of the perishable nature of mushrooms, sellers are forced either to sell their unsold fresh produce at the end of the day for a low price, or dry it before it perishes. Processing can assist marketing, by extending shelf life for small scale producers until they need to sell their product and also by adding value (Steinbuch, 1986).

Gourmet mushroom growers, large and small, always end up with harvested mushrooms that are not good enough for fresh sales to consumers. The mushrooms may have cosmetic defects, or you may have more mushrooms than customers. One of the best ways to turn that surplus into profits is to make value-added products to market that can be stored until sold (Wallin, 2011).

Considerable quantities of mushrooms are lost during glut period. Hence in order to stabilize production, it is of interest to devise techniques for the production of different value added mushroom products to meet the year round demand (Bano *et al.*, 1997).

Unprocessed mushrooms take up a lot of room and this can be a costly way of preserving them. By making value added products it can be stored in an economic viable way (Elaine and Nair, 2009).

Sometimes a grower may not be able to fill demand of consumers due to several constraints. There are also times when the demand decrease suddenly, the grower will want to save the extra that he has, so that they can be sold later. Adding value to the excess mushrooms thus produced is the best method (Rai *et al*., 2007).

2.6. EMPOWERMENT THROUGH VALUE ADDITION

Improved post-harvest handling, processing and marketing achieves value added products and is perhaps the most viable means by which to reduce poverty and improve rural livelihoods (Norman *et al*., 2002). There is inevitability of mushroom value addition for agricultural development and economic growth as

well as to get out of the poverty traps of millions of peasant's household in India (Deshpande, 2005).

Mushroom processing and value addition can alleviate poverty, eradicate malnutrition, create employment opportunity for educated, uneducated youths, men and women. It can be a suitable job for poor people and alternative income source for all (Alom and Bari, 2010).

Value addition of agricultural commodities through minimal and ultimate processing primarily reduces wastage, ensures additional income to the producers and also secures farmers income against a slump in price for fresh produce during a market glut (Anonymous, 2006).

Value addition in agriculture predominantly offers a means to increase, rejuvenate and stabilize farm income. Value addition in agriculture plays a leading role for rural employment as well as provides livelihood to a very large section (Roy *et al*., 2013). India has a tremendous potential for development in this sector as well as to increase farmer's additional income, rural employment generation and socio-economic upliftment (Anonymous, 2006).

A study conducted by Ali (2004) highlighted the significance of value addition in agriculture. Consensus from this study suggests that value addition in agriculture has vast untapped opportunities for increasing employment and revitalize rural communities, diversify the economic base of agricultural communities, increase farmers financial stability and opportunities for smaller farms and companies through the development of niche markets.

Value addition in mushroom is a promising enterprise especially for the unemployed educated women because it is basically an indoor activity and can be effectively managed by women (Harsh and Joshi, 2008).

Mushroom growers, large and small, always end up with harvested mushrooms that are not good enough for fresh sales to consumers. The mushrooms may have cosmetic defects, or you may have more mushrooms than

customers. One of the best ways to turn that surplus into profits is to make its value-added products to market that can be stored until sold (http://www.profitableplants.com).

Progressive farmer (2000) reported that there is going to be good demand for processed and fast foods and serious thoughts has to be given to bring product diversification and mushroom processing in order to compete in the international market.

The Home Science unit provides practical training programmes related to value addition for women groups with the main objective to generate entrepreneurial skills for women both as SHG's and individually, so that they can initiate their own self-employment ventures thereby helping in their social and economic empowerment **(**http://www.kvkidukki.org/productionunit.php).

Presently, the farmers selling their products without any processing if they do primary processing and value addition in villages. It will generate more income and employment in rural sector. The processing of food will generate employment in rural areas and can avoid food losses. If agro processing centre is established in each big village or for a group of small villages for primary processing this will generate employment for about 4-5% and will increase income of farmers or processors by 15-20% (Desai *et al*., 2007).

According to Donatha (2013), different methods were found to be used by different communities for both short and long term preservation to ensure supply of mushrooms all through the year. In the local open markets, both fresh and dry mushroom were sold and the dry mushrooms were sold at relatively higher prices compared to fresh mushrooms.

Pathak *et al*. (1998) found that Sikkim being famous for its tourism industry, create a high demand for mushroom delicacies in the hotel business. Mushroom processing unit and value addition is another big avenue in itself, which will be more profitable and also employment generating.

Another study conducted by Sabitha (2008) reported that 80.00 % of the respondents opined that women entrepreneurship through mushroom farming can be successful only if value added items in mushroom can be given due importance.

In a case study reported by Hoyle (2014), it was found that Nicola Mac Pherson and her husband, Daniel Hellmuth, have grown shiitakes in the Missouri Ozarks on three acres and they produced associated products from mushrooms such as pasta sauces, pickled mushrooms and canned mushroom which helped to maintain better prices.

NRCM (2004-05) showed that the evaluation studies conducted after giving mushroom value addition training for small scale mushroom growers of three kudumbasree units revealed that 90% of them were successful as entrepreneurs.

According to Meena and Singh (2013), the on campus and off campus training on various value addition and processing techniques for 3000 women in a time period of 8 yrs helped in supplementing their income.

Materials and Methods

3. MATERIALS AND METHODS

This chapter deals with the methodology followed in this study entitled "Empowerment of mushroom growers through technology transfer of value added products".

Materials and methods followed for the study are presented under the following headings.

3.1. Conduct of the Study

3.2. Selection of Mushroom Varieties

3.3. Selection of Mushroom Products

3.4. Standardisation of the Products

3.5. Acceptability of Value Added Mushroom Products

3.6. Shelf Life Studies of the Product Standardised

3.7. Cost Analysis

3.8. Technology Transfer of Value Added Products

3.9. Programme Evaluation

3.10. Statistical Analysis

3.1. CONDUCT OF THE STUDY

The study was carried out in two experiments under the first experiment, selection of mushroom varieties, standardisation of mushroom products, shelf life quality of these mushroom products and cost analysis of the products were ascertained. Technology transfer of these standardised products was conducted among selected human volunteers through a training programme were investigated in the second experiment.

3.2. SELECTION OF MUSHROOM VARIETIES

Most versatile and commercially cultivated varieties of mushrooms such as Oyster mushrooms (*Pleurotus florida*) and Milky mushrooms (*Calocybe indica*) were purposively selected for the study.

These mushrooms were collected from the Instructional farm, College of Agriculture, Vellayani and also from the local mushroom growers in Thiruvananthapuram.

3.3. SELECTION OF MUSHROOM PRODUCTS

Based on the available literature and discussion with subject matter specialists, five innovative processed mushroom products were identified for the formulation of value added products. Priority was given to processed products having market value as well as viability in takeover of the processing technique by mushroom growers with their limited resources.

The products thus identified were,

Dehydrated Mushroom

Mushroom Soup Powder

Mushroom Chutney Powder

Mushroom Pickle

Mushroom Wafers

3.4. STANDARDISATION OF THE PRODUCTS/ RECIPES

Standardisation of recipes are essential to strive for the same high quality, every time a product is stored (Crusius, 1984). First step for the standardisation procedure is the collection of novel recipes from the standard cookery books, journals and magazines. Necessary modifications in the basic recipes are to be made at the laboratory level and the recipes are finalised. According to Tolute

Mushroom chutney powder

Mushroom soup powder

Mushroom wafers

Mushroom pickle

Dehydrated mushroom slices

Plate 1. Value added products of mushroom

(2000), the procedure for recipe standardisation begins with the process of recipe modification or adjustment. Next step is the preparation of the products according to the recipe formulated. In this procedure, the ingredients are to be accurately weighed and cooked at a specific temperature in accordance with the finalised standard recipe. The flowcharts for the preparation of the recipes are given below.

These recipes were selected because of the following reasons:

The technology to be transferred was simple and appropriate. Ordinary cooking methods such as steaming, drying, frying, roasting etc. were used for the preparation of recipe.

The ingredients used in the recipes chosen were locally available and commonly used by all and were not very expensive. The modified recipes were tested several times at the laboratory level until satisfactory results were obtained.

1) Mushroom Chutney Powder

Mushroom (washed & cut into small pieces)

↓

Steaming (10 min)

↓

Mixing pepper powder, vinegar and salt

↓

Drying in a hot air drier(74°c for 2-3 hrs)

↓

Heating oil

↓

Adding coconut and frying

↓

Adding chopped ginger and powdered bengal gram dhal and frying till brown

↓

Adding dried mushroom, chilly powder, curry leaves, asafoetida, tamarind and salt and frying

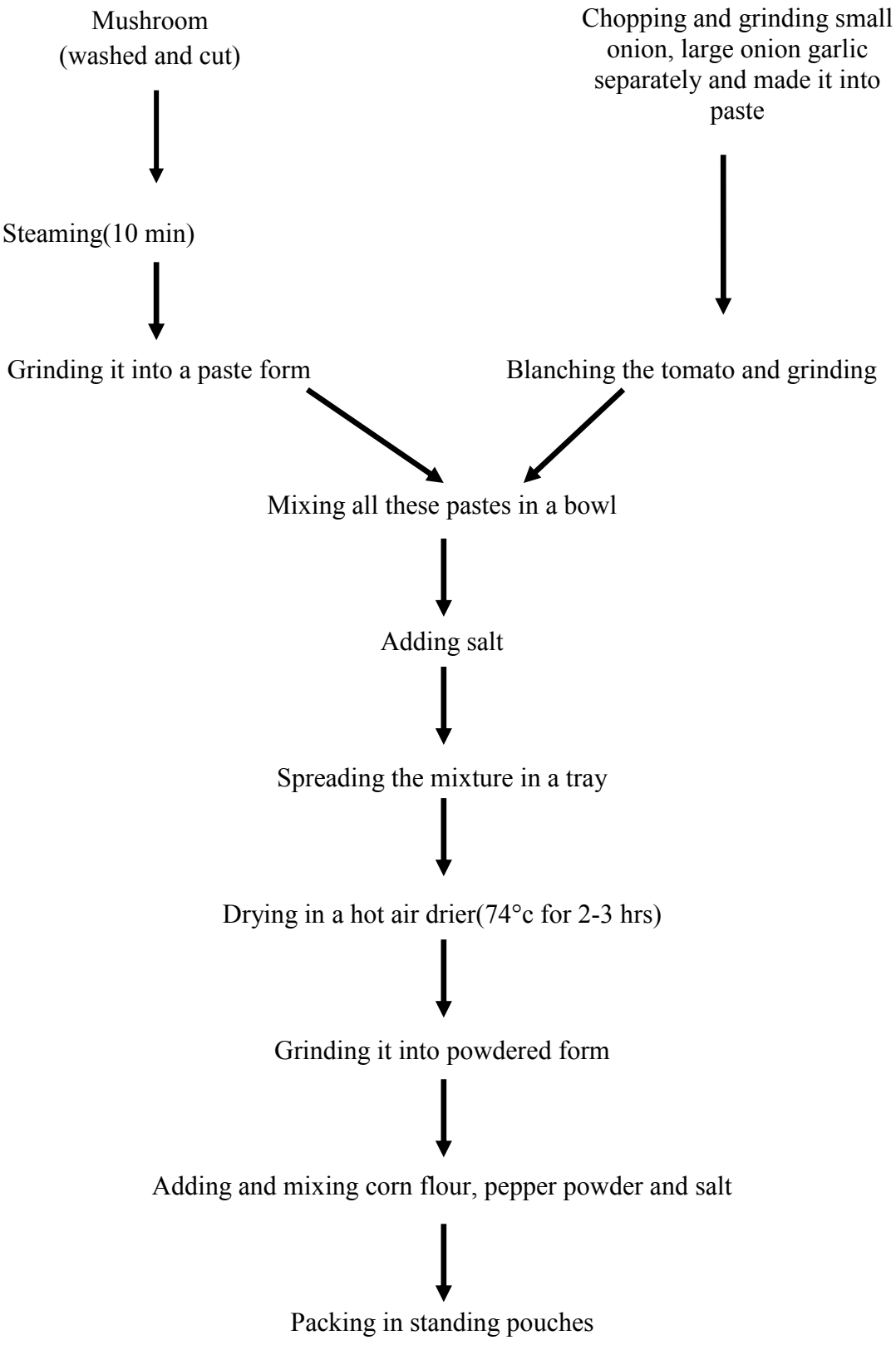
↓

Grinding in a mixer when it is slightly warm until all the masalas are well blended

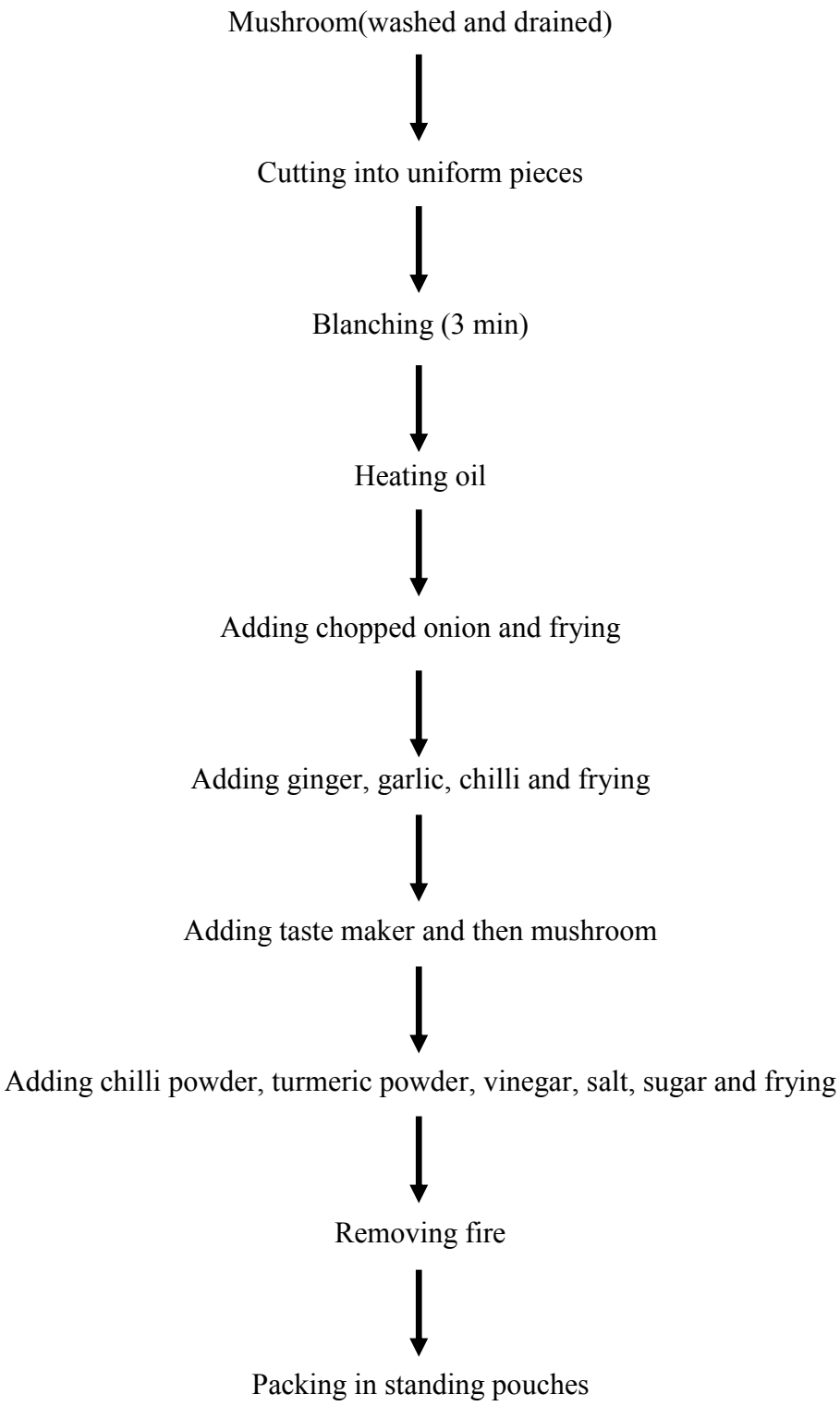
↓

Filling in polythene standing pouches

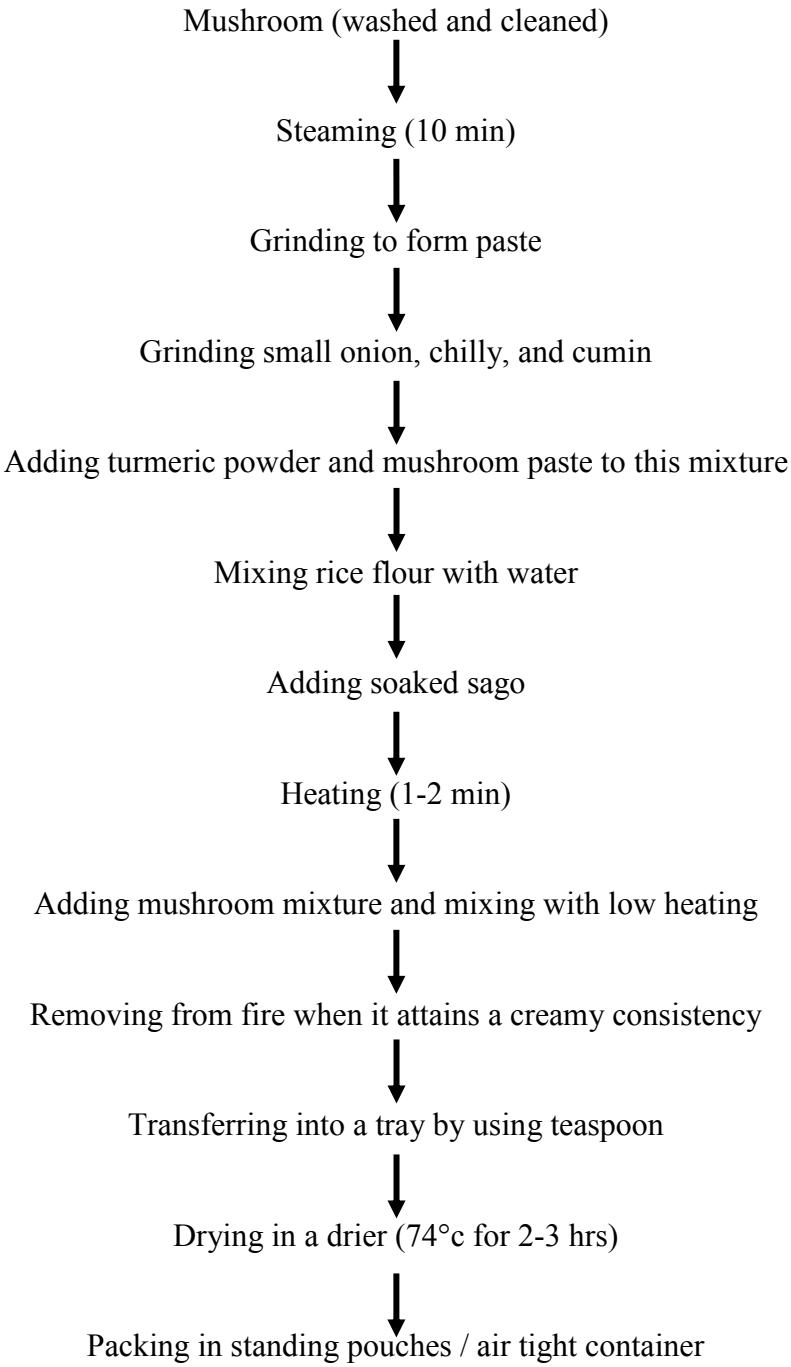
2) Mushroom Soup Powder



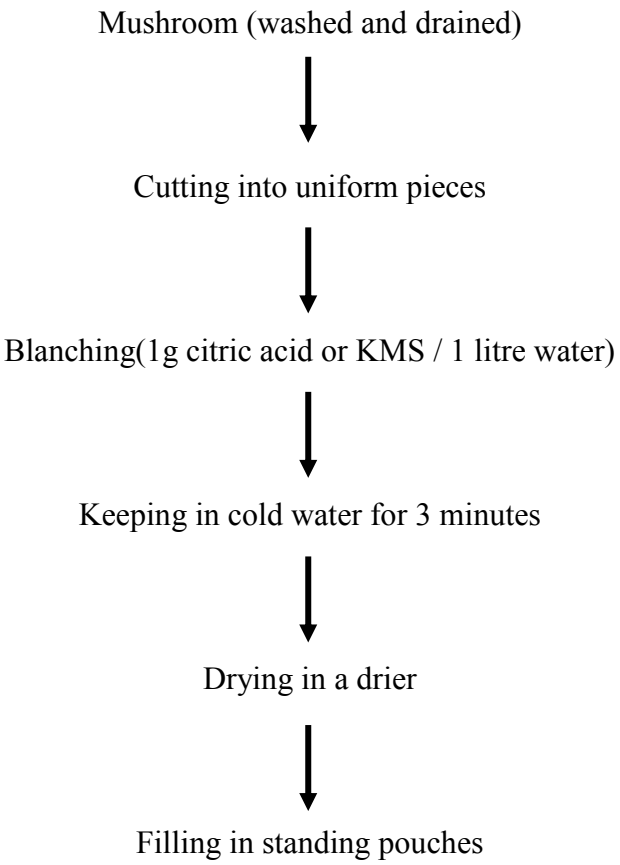
3) Mushroom Pickle



4) Mushroom Wafers



5) Dehydrated Mushroom



3.5. ACCEPTABILITY OF VALUE ADDED MUSHROOM PRODUCTS

3.5.1. Organoleptic Evaluation

Organoleptic evaluation of the five processed products immediately after the preparation was carried out by a panel of 10 judges with the help of a score card. Jellinick (1985) reported that organoleptic observations are done mainly to draw conclusion about a particular food from a large population through the selection of limited number of panel members.

The products prepared were kept in clear plates so that the judges could see the colour and appearance very clearly. The dehydrated mushrooms were rehydrated and made into products which were then evaluated for its organoleptic parameters. Scoring test was used for quantity evaluation as suggested by Swaminathan (1974). A five point rating scale was applied for each quality. The major quality attributes included for scoring were appearance, colour, taste, flavour and texture. The score card on these lines were prepared and distributed among the panel members to express their scores for organoleptic quality of the samples. Details of the score card are presented in Appendix I.

Judges were also permitted to take enough time to score the samples leisurely. The testing was conducted in the mid morning between 10 am to 11 am,since this time is considered as the ideal time for conducting the quality evaluation studies (Swaminathan, 1974).

3.5.2. Consumer Preference Test

Consumer preference study was conducted among thirty members inorder to assess the suitability of these products from the consumer's point of view. Preference tests allow consumers to express a choice between samples; one sample is preferred and chosen over another or there is no preference (Watt, 1999). A preference test was conducted by asking the consumers to rank or score the products served in the sequence of their liking. The preference evaluation was made inorder to select the most promising products for large scale production.

Consumer preference was assessed by Hedonic rating test. The hedonic rating test is used to measure the consumer acceptability of food products. The selected samples were served to the panellist in one session and they were asked to rate the acceptability of the products on a five point scale ranging from 'like extremely' to 'neither like nor dislike'. The five point scale is given in Appendix II.

3.6. SHELF LIFE STUDIES OF THE PRODUCTS STANDARDISED

To assess the shelf life stability of the products, they were kept sealed in a polypropylene cover and kept at ambient conditions for a period of three months. According to Bhattacharjee and Bhole (1999), food packing and storage is the vital step to ensure product quality because it provides protection against deterioration and damage during storage, transportation and distribution. The shelf life qualities of the products were analysed in terms of changes in chemical and sensory/ organoleptic qualities and occurrence of microbial infestation in the product. Changes in these parameters of the standardised products were monitored initially after the preparation of the products and periodically once in a month upto a period of three months. Assessment of shelf life quality is important since it determines the suitability of a particular ingredient of product development (Livingstone *et al*., 1993). Thakur *et al*. (1995) reported that the chemical and sensory changes are influenced by storage period and containers used for storage.

3.6.1. Assessment of Organoleptic Qualities of the Products

According to Jellinick (1985), chemical indices of deterioration alone will not decide the quality changes and it should be correlated with sensory evaluation of stored products. Hence periodical evaluation of the products was carried out with respect to the sensory parameters using a scorecard by the selected panels to understand the deteriorative changes occuring in these products during the storage period of three months.

3.6.2. Assessment of Changes in Chemical Characteristics with Storage

The chemical qualities in the products were analysed initially and periodically each month to observe the effect of storage on keeping quality. Samples were drawn from each of the products randomly in required quantities.

For analysis, the following parameters were assessed,

3.6.2.a. *Moisture*

Moisture content was estimated by the method of A. O. A. C (1990).

3.6.2.b. *Peroxide Value*

Method suggested by Sadasivam and Manikckam (1992) was used for estimating peroxide value.

3.6.2.c. *Acidity*

Acidity was estimated by method of A. O. A. C (1995).

3.6.2.d. *pH*

Estimated using digital pH meter.

3.6.3. Assessment of Microbial Profile of the Products

The samples of the products were assessed for the presence of various micro-organisms viz, bacteria, fungus and moulds initially and throughout the storage period of three months. Serial dilution of samples followed by the pour plate method (Johnson and Curl, 1972) was employed to estimate the population of viable micro-organisms in these processed products. Nutrient Agar (NA), Eosin Methylene Blue (EMB), Ken Knights reagent (KE) and Rose Bengal (RB) medium were used for culturing of bacteria, fungi and moulds respectively.

The procedure adopted for serial dilution was as follows. 1g weight of the product was transferred to 99ml of sterile water taken in a conical flask. Under aseptic conditions in laminar flow chamber 1ml of the suspension was withdrawn

from the first dilution using a sterile pipette and added to 9ml portion of sterile water taken in test tubes of 25ml capacity to prepare 10^{-2} dilution. Likewise, further dilutions of 10^{-3}, 10^{-4}, 10^{-5} were prepared using a fresh sterile pipette. In each case, one ml of each dilution (10^{-3}, 10^{-4}, 10^{-5}) was poured into a sterile petridish using a sterile pipette and 15ml of molten agar at 45°C was poured inside the laminar airflow chamber. The contents were mixed by circular movement in clockwise and anti clockwise directions. The molten agar was allowed to solidify and the plates were kept in an inverted position in BOD incubator set at the required temperature for each organism. After the incubation the colonies developed on the agar surface were counted and the counts were recorded as colony forming units by multiplying with the dilution factor. The microbial load of the samples was then expressed as cfu/g of the product.

3.7. COST ANALYSIS OF THE PRODUCT

3.7.1. Yield Percent

The weight of the product in relation to raw material used was calculated using the formula.

$$\text{Yield \%} = \frac{\text{Weight of Product Obtained}}{\text{Weight of raw ingredients}} * 100$$

3.7.2. Cost Analysis

Cost benefit analysis was carried out based on the input cost i.e., cost of different ingredients used for the preparation of each of these products, cost of packaging material and output cost (the total input cost and added 10% as overhead charges for fuel and labour).

3.8. TECHNOLOGY TRANSFER OF VALUE ADDED PRODUCTS

3.8.1. Selection of Respondents/ Subjects

Twenty five prospective mushroom growers interested in mushroom processing and value addition were purposively selected from the list of mushroom growers who were earlier trained at College of Agriculture,Vellayani, forming the study sample.

3.8.2. Assessment of Socio Economic Status of the Respondents

To elicit information on personal and socio economic profile of the respondents, details regarding age, religion, educational status, family income, family size, type of family etc. were collected using a pre designed questionnaire which is given in Appendix IV. Detailed information regarding production and sale, current practices on storage, spoilage, value addition, sale of products, market awareness on processed mushroom products also were collected. A suitably structured questionnaire was developed using standard procedure and was administered to the respondents which is given in Appendix V. The questionnaire was prepared in English and was translated into Malayalam before administering to the respondents.

3.8.3. Assessment of Knowledge and Attitude Scale of the Respondents

3.8.3.1. *Measuring Knowledge of the Respondents towards Value Addition of Mushrooms*

Knowledge is a body of understood information possessed by an individual or by culture, whichis in accordance with established facts (Henerson *et al*., 1987). In order to measure the knowledge level of the mushroom growers regarding mushroom value addition, a knowledge test was developed by means of a simple teacher made objective type test constructed following the procedure adopted by Kumar (2000) with slight modifications. An item pool of twenty statements relevant to mushroom processing and value addition was prepared. These statements were prepared from relevant literature.Both positive and

negative statements were formed. Care was taken to use simple and clear statements with no ambiguity in language or idea to avoid confusion and doubts. These were analysed by experts and in light of the suggestions made by them ten statements were selected for constructing the knowledge test.

The responses were collected in a dichotomous pattern i.e., Yes or No. Each correct response was given a score of one and the incorrect response was given a score of zero. Finally the scores were added up to get the knowledge score for each respondent. The maximum score for the test developed was 10 and the minimum score was 0. The constructed knowledge test administered is given in AppendixVI.

3.8.3.2. *Measuring attitude of the respondents towards value addition of mushrooms*

Thurstone (1946) defined attitude as the degree of positive or negative effect associated with some psychological object towards which people can differ in varying degrees. As attitude cannot be directly measured and has to be inferred from the opinion and expression of the individual, it is imperative to have as many as clear and simple statements as to provide opportunity to the respondents to reveal the extremes of his or her attitude (Bagchi, 1999).

Attitude of the respondents towards value addition of mushrooms was measured by developing an attitude scale using Edward's method (1957). For measuring the attitude of the respondents, 20 statements showing both positive and negative attitude towards value addition of mushrooms were collected from available literature. These were later circulated among the faculty members and students for selecting the most appropriate statements for the scale. Finally ten statements were selected for the attitude scale. Responses for each item were obtained on a five point scale ranging from 'strongly agree' to 'strongly disagree'.

The scores assigned were "Strongly agree - 5", "Agree - 4", "Undecided - 3","Disagree - 2", "Strongly disagree - 1". Negative statements were scored in the reverse manner. The attitude score of the respondents was obtained by adding up

the score corresponding to their response pattern for each statement. There was thus a possibility for a respondent receiving a maximum score of 50 and a minimum score of 0. The attitude scale developed is presented in Appendix VII. The attitude scale developed was administered to the respondents.

3.8.4. Conduct of Training Programme

Roy *et al.* (2013) defined training as a kind of learning process where a selected group of individuals undergo learning experience to internalise the skills, resulting in modifications of behaviour towards job performances. The training programme was conducted for the selected twenty five mushroom grower's continously for three days at the College of Agriculture, Vellayani.

The first day of training programme started with an inauguration programme where, the importance of value addition in mushroom was discussed as the main theme. After that the respondents were given the questionnaire to obtain their socio-economic status data. Apart from that their attitude and knowledge levels were also analysed using attitude and knowledge measuring scale, prior to the training programme.

On the first day, a method demonstration on the preparation of mushroom chutney powder and mushroom soup powder mix was conducted along with the participation of the respondents.

Method demonstration is a teaching method with both large and small groups. Demonstration becomes more effective when verbalisation accompanies them. For e.g., in a half demonstration half lecture an explanation accompanies the actions performed. It is a generally accepted learning theory that the greater the degree of active participation and sensory involvement by the learner, the more effective learning will be (Chernoff, 1994).

On the second day of training, the preparation of the mushroom products such as mushroom wafers, mushroom pickles and dehydrated mushroom were demonstrated.

Plate 2. Conduct of training programme




Plate 3. Distribution of fresh mushrooms

On the last day of training all of the respondents were asked to make some value added products from mushroom and a competition was conducted among the respondents to assess the expertise gained by them.

3.8.5. Distribution of Reference Material

A book entitled "Mulyavardhitha Koon Ulpannangal" was prepared in malayalam. The introduction part of book included nutritional and therapeutic value of mushroom and importance of value addition in mushroom. Forteen recipes of the value added mushroom products were included. The booklet was distributed to the participants as reference material to be used later. A copy of the booklet is appended in Appendix VIII.

3.9. PROGRAMME EVALUATION

In order to evaluate the impact of training programme, change in knowledge and attitude of the respondents was assessed immediately after the programme. Also, details regarding the adoption of mushroom processing, sale of products and market linkages, income generated, problems and constraints was also assessed after two months in order to evaluate the impact of transfer of technology of mushroom processing.

3.10. STATISTICAL ANALYSIS

The data collected were scored, coded, consolidated and subjected to statistical analysis and interpretations. The statistical procedures used in the present study were:-

(a) Percentage

(b) Mean Score

(c) Anova

(d) Paired T-test

Products prepared for the competition

Judging of the products

Prize distribution

Plate 4. Conducting competition among the respondents

Plate 5. Distribution of booklet

Results

4. RESULTS

The present study "Empowerment of mushroom growers through technology transfer of value added products" emphasises on the exploitation of mushrooms as a source of income generation for the mushroom growers. A group of mushroom growers were given training in value addition in mushrooms through method demonstration with the objective of improving their socio economic status. The results obtained are presented under the following headings.

4.1. Acceptability of value added mushroom products

4.2. Yield percent and cost analysis

4.3. Shelf life quality of value added mushroom products

4.4. Personal and socio economic characteristics of the respondents

4.5. Details regarding mushroom cultivation, production and training

4.6. Details regarding marketing of fresh mushrooms

4.7. Details regarding spoilage of mushrooms

4.8. Details on processing aspects of mushrooms

4.9. Impact assessment of training programme

4.1. ACCEPTABILITY OF VALUE ADDED MUSHROOM PRODUCTS

4.1.1. Organoleptic Evaluation of Mushroom Products

Scientific assessment of sensory analysis of food is now becoming increasingly important in evaluating the acceptability of the food product. When the quality of the food is assessed by human sensory organs, the evaluation is said to be sensory analysis (Simi, 2002). According to Thakkar and Shah (2009) sensory analysis is a technique that uses man as a measuring instrument.

Numerical scoring test is used to evaluate particular characteristics of one or more samples indicating the rating as excellent, very good, good, fair and poor (Manay and Swami, 2002). Accordingly, the mushroom products prepared i.e., mushroom chutney powder, mushroom soup powder, mushroom pickle, mushroom wafers and products that were incorporated with dehydrated mushrooms were assessed organolepticallly by a panel of ten judges using a score card on a five point scale. The data is presented in the table 1.

Table 1. Organoleptic evaluation of developed mushroom products

Mean scores for quality attributes						
Products	Appearance	Colour	Flavour	Texture	Taste	Over all acceptability
Mushroom chutney powder	4.6	4.6	4.8	4.6	4.7	4.8
Mushroom soup powder	4.8	4.8	4.9	4.7	4.8	4.8
Mushroom pickle	4.8	4.8	4.9	4.8	4.7	4.8
Mushroom wafers	4.1	3.7	3.7	4.1	3.7	3.9
Dehydrated mushrooms	4.6	4.6	4.2	4.5	4.6	4.5

Appearance

The first impression of food is usually visual and a major part of willingness to accept a food depends on its appearance. From table 1, it is revealed that the mean score of appearance for mushroom chutney powder was 4.6 and that of mushroom soup powder was 4.8. Mushroom pickle is also having a mean score of 4.8 and mushroom wafers are having a mean score of 4.1. Dehydrated mushrooms which were made into mushroom curry also scored a mean score of 4.6 for appearance.

Colour

Colour is one of the important visual attributes that has been used to judge the overall quality of foods for a very long time. If the colour is unattractive, a potential consumer may not be impressed by any other attributes. The mean score of colour obtained for mushroom pickle and mushroom soup powder was 4.8. While mushroom chutney powder and dehydrated mushroom obtained a mean score of 4.6. The mean score for mushroom wafers was 3.7. All the products are found to be having high scores with respect to colour.

Flavour

Odour preference is generated by stimulation of the sensory cells by specific volatile compounds present in the foods. It can be seen that both mushroom soup powder and mushroom pickle obtained mean score of 4.9 and the mean score of mushroom chutney powder and dehydrated mushroom is 4.8 and 4.2 respectively which can be considered as having good flavour. Mean score of 3.7 was scored by mushroom wafers which can be considered to be fair in flavour.

Texture

Texture constitutes a physical property of food stuffs apprehended by eye, skin and muscle senses located in the mouth. The average score of texture for mushroom pickle is 4.8 and that of mushroom soup powder is 4.7, mushroom chutney powder is 4.6, mushroom wafers 4.1 and dehydrated mushroom is 4.5.

Taste

Taste is the major attribute which determines the ability of a food. It is not only a sensory response to soluble materials but also an aesthetic appreciation of the mouth. The taste of the different mushroom products ranged from 3.7 to 4.8. Mushroom soup powder obtained a mean score of 4.8, mushroom chutney powder and mushroom pickle obtained mean score of 4.7 and dehydrated mushroom obtained a mean score of 4.6. The mean score for mushroom wafers is 3.7 which can be considered as fair in taste.

Overall Acceptability

Overall acceptability of these mushroom products were also calculated using the mean score value and from the table 1, it is revealed that three products namely mushroom chutney powder, mushroom soup powder and mushroom pickle obtained a score of 4.8. The mean score of dehydrated mushroom was seemed to be 4.5 and that of mushroom wafers was 3.9.

4.1.2. Consumer Preference

Today consumers are more conscious of a large range of food products available in the market. New foods/Novel foods are rapidly increasing in number in the markets. Consumer acceptance of a new product is based largely on its convenience, appearance, sensory value, economic value and health benefits. In this study, the consumer preference for these five mushroom products was done by thirty members using a five point Hedonic rating scale.

Table 2. Consumer preference of developed mushroom products

Products	Like extremely	Like very much	Like moderately	Like slightly	Neither like nor dislike
Mushroom chutney powder	26 (86.6)	4 (13.4)	-	-	-
Mushroom soup powder	23 (76.6)	7 (23.4)	-	-	-
Mushroom pickle	21 (70)	9 (30)	-	-	-
Mushroom wafers	5(16.6)	10 (33.4)	15 (50)	-	-
Dehydrated mushroom	22 (73.2)	4 (13.4)	4 (13.4)	-	-

* Figures in parenthesis indicate percentage score

As revealed in the table 2, mushroom chutney powder was liked extremely by the majority (86.6%) of the respondents, whereas mushroom soup powder was liked extremely by 76.6%, mushroom pickle (70%), mushroom wafers (16.6%) and dehydrated mushrooms (73.2%). Mushroom pickle was liked very much by 30 per cent of the respondents while mushroom wafers was liked moderately by 50 percent of the respondents and 13.4 per cent moderately liked the dehydrated mushrooms.

4.2. YIELD PERCENT AND COST ANALYSIS

4.2.1. Yield Percent

Drying removes moisture, the food shrinks and decreases in size and weight, thus requiring less space for storage. Yield of dried products are directly related to how much water is in the original product. The yields of the developed mushroom products are given in Table 3.

Table 3. Yield percent of the developed mushroom products

Name of product	Weight of raw ingredients (gm)	Weight of final product (gm)	Yield percent (%)
Mushroom chutney powder	2360	955	40.46
Mushroom soup powder	2520	230	9.12
Mushroom pickle	1544	680	44.04
Mushroom wafers	1975	732	37.06
Dehydrated mushrooms	1000	96.5	9.65

From the table 3, it is revealed that the highest yield percent was obtained for mushroom pickle (i.e., 44.04 per cent), followed by mushroom chutney powder (40.46 per cent), mushroom wafers (37.06 per cent), dehydrated mushrooms (9.65 per cent) and mushroom soup powder (9.12 per cent).

4.2.2. Cost Analysis of Developed Mushroom Products

The cost of the developed mushroom products was calculated on the basis of the market value of ingredients used for the formulation of these products and the overhead charges needed for processing each item. In order to realize the economic feasibility of the developed mushroom products the cost was calculated by taking individual cost of the ingredients used with 10 per cent over head. Table 4, shows details of production cost of 10gm value added mushroom products.

Table 4. Cost analysis of developed mushroom products

Name of the product	Production cost/ serving (Rs.)
Mushroom chutney powder	4.5
Mushroom soup powder	13
Mushroom pickle	5.2
Mushroom wafers	4
Dehydrated mushrooms	27

* 10gm of the finished products

Here, the cost of different value added mushroom products revealed that the cost obtained for dehydrated mushrooms is Rs.27 and that of mushroom soup powder is Rs.13, mushroom pickle is Rs.5.2, mushroom chutney powder is Rs.4.5 and mushroom wafers is Rs.4.

4.3. SHELF LIFE QUALITY OF VALUE ADDED MUSHROOM PRODUCTS

Assessment of shelf life quality is important since it determines the suitability of a particular ingredient for the product development. Shelf life is the recommendation of time that products can be stored, during which the defined quality of a specified proportion of the goods remains acceptable under expected conditions of distribution, storage and display (Azanha and Faria, 2005). The factors like raw material quality, storage temperature, storage containers, procedures employed and the environment in which it is processed affects the shelf life quality (Shankar, 1993).

The shelf life quality of developed value added mushroom products such as mushroom chutney powder, mushroom soup powder, mushroom pickle, mushroom wafers and dehydrated mushrooms was analysed by assessing the sensory parameters, chemical parameters and microbial profile for four months at monthly intervals.

4.3.1. Organoleptic Changes of Stored Mushroom Products

Sensory evaluation plays an important role in determining the acceptability and shelf life stability of the food products. The chemical indices of deterioration alone will not decide the quality changes and it should be correlated with sensory evaluation of stored products. Hence periodical evaluation of the products was carried out with respect to the sensory parameters to understand the deteriorative, changes occuring in the stored products. The mushroom products were evaluated initially and after the storage period of four months for appearance, colour, flavour, texture and taste.

4.3.1.1. *Changes in the organoleptic qualities of mushroom chutney powder during storage*

Effect of storage on the organoleptic qualities of mushroom chutney powder was assessed to study the shelf life and also to test the quality change. The mean

scores of the organoleptic qualities of mushroom chutney powder during the storage period of four months are presented in table 5.

From the table it can be seen that the scores obtained for appearance has not changed at the end of third month (4.7) and during fourth month it had only a slight decrease (4.6). In case of colour, the mean score was 4.6 during first two months and at the end of third month it had slightly decreased to 4.5 and this value is retained at the end of fourth month. Flavour also did not showed any difference during the storage period of two months i.e., 4.8 and after that it was found lowered only to 4.7 by the third month and no change was noticed from third month to fourth month. When the texture of product was assessed on storage periods, there was no change in the first two months and no noticeable reduction in score was seen as it has only changed from 4.5 to 4.4. For taste, superior score was obtained during the first month. Only a slight reduction in score (4.6) was recorded by the end of third month. Similar trend was noticed up to fourth month (4.5) of storage period.

Table 5. Effect of storage of mushroom chutney powder on various quality attributes

Quality attributes	Mean Organoleptic Scores				
	Initial	1st month	2nd month	3rd month	4th month
Appearance	4.7	4.7	4.7	4.7	4.6
Colour	4.6	4.6	4.6	4.5	4.5
Flavour	4.8	4.8	4.8	4.7	4.7
Texture	4.5	4.5	4.5	4.4	4.4
Taste	4.7	4.7	4.7	4.6	4.5
Overall acceptability	4.6	4.6	4.6	4.5	4.5

4.3.1.2. *Changes in the organoleptic qualities of mushroom soup powder during storage*

Variations in the organoleptic qualities of mushroom soup powder on storage were measured to study the influence of storage on this product. The mean scores of the organoleptic qualities of mushroom soup powder during the storage period of four months are given in Table 6.

The periodical evaluation of mushroom soup powder record that the mean score obtained for appearance, colour and taste was 4.8 and only a slight

fluctuation was found at the end of fourth month. The score for appearance, colour and taste at the end of fourth month was observed to be 4.7. The flavour and texture of the mushroom soup powder remained constant during the storage period. The mean score for flavour is 4.9 and that of texture is 4.7.

Table 6. Effect of storage of mushroom soup powder on various quality attributes

Quality attributes	Mean Organoleptic Scores				
	Initial	1st month	2nd month	3rd month	4th month
Appearance	4.8	4.8	4.8	4.8	4.7
Colour	4.8	4.8	4.8	4.8	4.7
Flavour	4.9	4.9	4.9	4.9	4.9
Texture	4.7	4.7	4.7	4.7	4.7
Taste	4.8	4.8	4.8	4.8	4.7
Overall acceptability	4.8	4.8	4.8	4.8	4.7

4.3.1.3. *Changes in the organoleptic qualities of mushroom pickle during storage*

Influence of storage on the organoleptic qualities of mushroom pickle was assessed through sensory evaluation tests. Table 7 depicts the mean scores of the

organoleptic qualities of mushroom pickle during the storage period of four months.

As presented in the table 7, it is evident that the mean score obtained for appearance did not show any difference until second month (4.9) then it slightly decreased to 4.8 at the end of third month and remained same at the end of fourth month. Coming to the colour of mushroom pickle it has scored 4.8 and this is unchanged till third month. During the fourth month it had slightly decreased and scored 4.7. In case of flavour it remain steady during the storage period. Texture of pickle remained unchanged during the first three months and then it slightly decreased to 4.7.

A close watch on the data revealed that there was a considerable increase in taste with increase in storage period. During the end of first month it was 4.7 then it had slightly increased to 4.8 at the end of second month and 4.9 during third month and this value remained static till the fourth month.

Table 7. Effect of storage of mushroom pickle on various quality attributes

Quality attributes	Mean Organoleptic Scores				
	Initial	1st month	2nd month	3rd month	4th month
Appearance	4.9	4.9	4.9	4.8	4.8
Colour	4.8	4.8	4.8	4.8	4.7
Flavour	4.9	4.9	4.9	4.9	4.9
Texture	4.8	4.8	4.8	4.7	4.7
Taste	4.7	4.7	4.8	4.9	4.9
Overall acceptability	4.8	4.8	4.8	4.8	4.7

4.3.1.4. *Changes in the organoleptic qualities of mushroom wafers during storage*

While concentrating on the values obtained for appearance of mushroom wafers on storage it is seen that there is no variation during first three months (4.1) and it had slightly decreased to 4 at the end of fourth month. Table 8, depicts the mean score obtained for colour, it was 3.7 during first two months and at the end of third month it had slightly decreased to 3.6 and this value is retained at the end of fourth month. Flavour also did not show any difference during the storage period of three months i.e., 3.6 and after that it was found lowered only to 3.5 by the fourth month. When the texture of product was assessed on different

storage periods, no change occurred in the first two months and there was no noticeable reduction in score as it has only changed from 4.1 to 4. For taste, the score obtained was 3.5 and it remained unchanged during the storage period.

Table 8. Effect of storage of mushroom wafers on various quality attributes

Quality attributes	Mean Organoleptic Scores				
	Initial	1st month	2nd month	3rd month	4th month
Appearance	4.1	4.1	4.1	4.1	4
Colour	3.7	3.7	3.7	3.6	3.6
Flavour	3.6	3.6	3.6	3.6	3.5
Texture	4.1	4.1	4.1	4	4
Taste	3.5	3.5	3.5	3.5	3.5
Overall acceptability	3.8	3.8	3.8	3.7	3.7

4.3.1.5. ***Changes in the organoleptic qualities of dehydrated mushroom during storage***

From the table 9, it is evident that mean value of appearance remained unchanged till second month and after that it decreased slightly to 4.5 during third month and 4.4 during fourth month. Colour of dehydrated mushroom was constant during the first three months and a slight variation was seen at the end of

fourth month. Flavour was seemed to be static in value during the entire period of storage. Coming to the texture of the product the score obtained was 4.5 for two months duration and showed only a small variation from third month of storage. It was clear from the score level that the taste of the product during first two months was 4.6 and it slightly decreased to 4.5 from third month and remained unchanged during fourth month.

Table 9. Effect of storage of dehydrated mushroom on various quality attributes

Quality attributes	Mean Organoleptic Scores				
	Initial	1st month	2nd month	3rd month	4th month
Appearance	4.6	4.6	4.6	4.5	4.4
Colour	4.6	4.6	4.6	4.6	4.5
Flavour	4.2	4.2	4.2	4.2	4.2
Texture	4.5	4.5	4.5	4.4	4.4
Taste	4.6	4.6	4.6	4.5	4.5
Overall acceptability	4.5	4.5	4.5	4.4	4.4

4.3.2. Chemical Changes of Stored Mushroom Products

4.3.2.1. *Chemical changes of mushroom chutney powder*

The shelf life quality of developed mushroom chutney powder was analysed by assessing the parameters like acidity, moisture, pH and peroxide.

In the table 10, it is depicted that the initial value of acidity of mushroom chutney powder was 0.463%. During the storage period of four months only a slight increase was noted and become 0.48% at the end of fourth month. There was no significant difference between these consecutive months as it showed only a slight increase in the acidity value.

It is evident from table 10, that the moisture content of mushroom chutney powder has an initial value of 2.74 percent and it is slightly increased to 2.76 percent after one month, 2.8 percent after two months, 2.83 percent after three months, 2.86 per cent after four months. All these values were seen to be on par.

The pH value of mushroom chutney powder was seen to slightly decreased during the period of storage. The initial value (5.2) was found to be on par with the pH value after one month (5.17). After second (5.13), third (5.1) and fourth (5.03) month of storage the value was seen to decrease but there was no significance difference between the months.

The peroxide value of mushroom chutney powder showed only a slight increase from initial value (0.166 meq/100gm) to 0.186 meq/100gm after one month, 0.223 meq/100gm after second month, 0.243 meq/100gm after third month, 0.283 meq/100gm after fourth month. No significance difference was noted among the consecutive months and the values were within the limits.

Table 10. Chemical changes of mushroom chutney powder

Chemical parameters	Initial value	First month	Second month	Third month	Fourth month	CD value
Acidity (%)	0.463	0.467	0.473	0.473	0.48	NS
Moisture (%)	2.74	2.76	2.8	2.83	2.86	NS
pH	5.2	5.17	5.13	5.1	5.03	NS
Peroxide (meq/100gm)	0.166	0.186	0.223	0.243	0.283	NS

4.3.2.2. *Chemical changes of mushroom soup powder*

The shelf life quality of developed mushroom soup powder was analysed by assessing the parameters like acidity, moisture, pH and peroxide.

In the table 11, it is depicted that the acidity of mushroom soup powder initially was 0.34 per cent. During the storage period of four months there is a slight increase was noted and at the end of fourth month it becomes 0.43 per cent. This was only a slight increase and was not statistically significant.

The initial value of moisture was noted as 0.52 percent and it exhibited a slight increase at the end of first month (0.53%). The moisture content during second (0.54%) and third (0.54%) month did not depict any significant difference. On the end of fourth month (0.55%) it showed only a small increase which was statistically non-significant.

When comparing the mean values of pH content of mushroom soup powder during the storage period, it was found that there were only a slight decrease from

the initial value (4.78) to first month (4.76), second month (4.73), third month (4.7) fourth month (4.66) and it was statistically on par with each other.

The peroxide values of mushroom soup powder are depicted in table 11. From the table, it is observed that there was no significant difference in the peroxide value during the storage period of four months. The initial value was 0.024 meq/100gm and final value at the end of the fourth month was 0.026 meq/100gm.

Table 11. Chemical changes of mushroom soup powder

Chemical parameters	Initial month	First month	Second month	Third month	Fourth month	CD value
Acidity (%)	0.34	0.35	0.35	0.40	0.43	NS
Moisture (%)	0.52	0.53	0.54	0.54	0.55	NS
pH	4.78	4.76	4.73	4.70	4.66	NS
Peroxide (meq/100gm)	0.024	0.024	0.024	0.025	0.026	NS

4.3.2.3. *Chemical changes of mushroom pickle*

The shelf life quality of developed mushroom pickle was analysed by assessing the parameters like acidity, moisture, pH and peroxide.

In the initial analysis, acidity of mushroom pickle was found to be 0.763% and after one month it became 0.766% and after second, third and fourth month it

slightly changed to 0.773%, 0.776% and 0.783% respectively. These scores were however on par with each other as there was only a slight increase in the acidity.

The moisture content in mushroom pickle is shown in table 12, and it was found that about 44.48% of moisture was found initially and after four months of storage it has slightly decreased to 44.36%. The results indicate that there was no significant decrease in the moisture content during the storage period from initial month to fourth month of storage and these values were within the limits.

Results indicate that the pH values ranged from 3.96 during the initial value to 3.7 at the end of fourth month. Any significant difference could not be elicited in the pH value of the mushroom pickle during the period of storage.

Initially, peroxide present in mushroom pickle was seemed to be 0.044 meq/100gm. After one month it slightly increased to 0.045 meq/100gm and no change was found until second month. During third month, a slight increase was found i.e.; 0.046 meq/100gm and this was seen to remain steady till the end of the fourth month.

Table 12. Chemical changes of mushroom pickle

Chemical parameters	Initial month	First month	Second month	Third month	Fourth month	CD value
Acidity (%)	0.763	0.766	0.773	0.776	0.783	NS
Moisture (%)	44.48	44.47	44.47	44.46	44.36	NS
pH	3.96	3.9	3.86	3.8	3.7	NS
Peroxide (meq/100gm)	0.044	0.045	0.045	0.046	0.046	NS

4.3.2.4. *Chemical changes of mushroom wafers*

The shelf life quality of developed mushroom wafers was analysed by assessing the parameters like acidity, moisture, pH and peroxide.

Result indicated that the initial value of acidity in mushroom wafers during storage period was 0.63%. After one month it was slightly increased to 0.65% and 0.7% after second month, 0.73% after third month, 0.76% after fourth month. The acidity of mushroom wafers does not have any significant difference statistically as it was only showed a slight increase. The moisture content of mushroom wafers also showed a slight increase (From 1.2 percent to 1.33 percent) during the storage period of four months and it was found to be on par.

The initial value of pH in mushroom wafers was noted as 4.9 and it has a slight decrease at the end of first month (4.86) which was seem to be on par. The pH content during second (4.83) and third (4.76) month also not depicts any significant difference. On the end of fourth month (4.7) it showed only a small increase and it was statistically non significant.

Table 13, reveals that the peroxide value of mushroom wafers has showed a small increase during the shelf life study. Initially the peroxide content was 0.012% and it become 0.013% during first month, 0.014% in second month, 0.014% in third month, 0.015% in fourth month and it was found to be on par.

Table 13. Chemical changes of mushroom wafers

Chemical parameters	Initial month	First month	Second month	Third month	Fourth month	CD value
Acidity (%)	0.63	0.65	0.7	0.73	0.76	NS
Moisture (%)	1.2	1.2	1.23	1.26	1.33	NS
pH	4.9	4.86	4.83	4.76	4.7	NS
Peroxide (meq/100gm)	0.0125	0.0133	0.0141	0.0147	0.015	NS

4.3.2.5. *Chemical changes of dehydrated mushrooms slices*

The shelf life quality of developed dehydrated mushroom was analysed by assessing the parameters like acidity, moisture, pH and peroxide.

It was found that the acidity of dehydrated mushrooms was not significantly different during the four consecutive months of storage period and only a slight decrease in the acidity value was seen. Initially acidity of dehydrated mushrooms was 0.327% which decreased to 0.3% at the end of shelf life study.

Result indicated that the moisture content of dehydrated mushrooms during the initial storage period was 2.43% and after one month it was slightly increased to 2.53%, 2.56% after second month, 2.63% after third month and 2.7% after fourth month. The moisture content of dehydrated mushrooms did not show any significant difference statistically.

With regard to the pH value of dehydrated mushroom, during the initial month the value was 4.63 and it was slightly increased to 4.66 after one month, 4.68 after second month, 4.69 after third month and 4.71 after fourth month and it was found to be on par with each other.

The peroxide value was not observed until the end of second month. Thereafter negligible value of peroxide was noted in the dehydrated mushrooms. The values are given in table 14. The table indicated that peroxide value on the second month of storage was 0.013 meq/100gm and it has slightly increased to 0.017 meq/100gm on third month and 0.023 meq/100gm on fourth month and it did not show any significant difference statistically.

Table 14. Chemical changes of dehydrated mushrooms

Chemical parameters	Initial month	First month	Second month	Third month	Fourth month	CD value
Acidity (%)	0.327	0.32	0.317	0.313	0.30	NS
Moisture (%)	2.43	2.53	2.56	2.63	2.7	NS
pH	4.63	4.66	4.68	4.69	4.71	NS
Peroxide (meq/100gm)	-	-	0.013	0.017	0.023	NS

4.3.3. Microbial Profile of Stored Products of Mushrooms

Analysis of microbial population in developed food products is important as it determines the quality and safety of food products. When foods are processed,

Table 15. Microbial population of mushroom products during fourth month of storage

Products	Bacteria			E - coli			Actinomycetes			Fungi		
	10^{-3}	10^{-4}	10^{-5}	10^{-3}	10^{-4}	10^{-5}	10^{-3}	10^{-4}	10^{-5}	10^{-3}	10^{-4}	10^{-5}
Mushroom chutney powder	Nil	Nil	Nil	Nil	Nil	nil	Nil	Nil	Nil	Nil	Nil	$1*10^{-5}$
Mushroom soup powder	Nil	Nil	Nil	Nil	Nil	nil	Nil	Nil	Nil	Nil	Nil	Nil
Mushroom pickle	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Mushroom wafers	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	$2*10^{-4}$	$1*10^{-5}$

there are chances of contamination through various means and during storage period, these microbes multiply and cause spoilage in the product. Hence the assessment of microbial population of the products is an essential step in the development of new products. The microbiological safety of food is achieved by ensuring the absence of pathogenic micro organisms and as far as possible through preventing their multiplication by all possible means (Beckers, 1988). Food products that have been subjected to an adequate heat treatment during processing are free of vegetative pathogens, thus initially it regarded as safe.

Microbial analysis of stored mushroom products was done to ascertain the shelf life stability of the products. All the five products (i.e., mushroom chutney powder, mushroom soup powder, mushroom pickle, mushroom wafers and dehydrated mushrooms) were stored in ambient conditions for a period of four months. The microbial evaluation was done initially and at 30 days intervals up to four months. The growth of bacteria, fungi, actinomycetes and E-coli were determined using Nutrient Agar (NA), Rose Bengal (RB), Ken Knights Agar (KEN), and Eosin Methylene Blue (EMB). The evaluation was done by serial dilution of the samples followed by pour plating technique suggested by Johnson and Curl (1972). The results are presented in Table 15.

During the storage period no bacterial colonies were found to appear in the developed mushroom products which were packed in the polypropylene pouches. But yeast colonies were seen in 10^{-5} dilution of mushroom chutney powder and in both 10^{-4} & 10^{-5} dilutions of mushroom wafers during the end of fourth month. Even though the growth of yeast colonies was observed, it was within the permissible limit. No other pathogenic organisms could be detected in the developed mushroom products.

4.4. PERSONAL AND SOCIO ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Personal and socio economic characteristics of selected fifty respondents with reference to age, sex, caste, type of family and income were assessed.

4.4.1. Age of Respondents

Table 16 reveals that about forty eight per cent of the respondents belonged to the age group thirty to forty years and about thirty two per cent of them belonged to the age group between forty to fifty years and remaining twenty per cent of the respondents belonged to the age above fifty years.

4.4.2. Sex of Respondents

The sex wise distribution of the respondents as depicted in Table 16, proved that majority of the respondents (Eighty per cent) were females and about twenty per cent were males.

4.4.3. Caste of Respondents

According to the religion wise distribution of the respondents indicated in Table 16, majority i.e., sixty per cent of the respondents belonged to the Hindu community and forty per cent belonged to Christian community.

4.4.4. Type of Family

Table 16, shows that majority of the respondents (92 per cent) belonged to nuclear family and eight per cent belonged to joint family.

4.4.5. Education of the Respondents

The educational status of the respondents when assessed was seen to range from S.S.L.C to post graduation. The status of the respondents revealed that thirty six per cent had studied up to High school. Twenty per cent had studied up to pre

degree, forty per cent had studied up to UG level and only four per cent had acquired post graduation.

4.4.6. Occupation of the Respondents

Table 16 gives a picture of occupation of the respondents and it reveals that the majority of the respondents (56 per cent) were housewives. Twenty four per cent of the respondents were doing agriculture and twelve per cent were working in private sector. Only eight per cent were working in government sector

4.4.7. Monthly Family Income of the Respondents

Table 16, revealed that a considerable percentage (i.e., 12 per cent) of the respondents had monthly income above Rs.15,000; forty per cent of the respondents had monthly income ranging from Rs.10,000 - 15,000; forty eight per cent of the respondents belonged to the income category with a monthly income less than Rs.10,000.

Table 16. Distribution of respondents based on their personal characteristics (n=25)

Variables	Category	Number	Percentage
Age	30 – 40	12	48
	40 - 50	8	32
	Above 50	5	20
Sex	Male	5	20
	Female	20	80

Religion	Hindu	15	60
	Christian	10	40
	Muslim	-	-
Type of family	Nuclear	2	8
	Joint	23	92
Education	S.S.L.C	9	36
	Pre degree	5	20
	BA/ BSc	10	40
	MA/ MSc	1	4
Occupation	Agriculture	6	24
	Housewife	14	56
	Govt sector	2	8
	Private sector	3	12
Monthly income	< 10,000	10	40
	10,000 - 15,000	12	48
	> 15,000	3	12

4.5. DETAILS REGARDING MUSHROOM CULTIVATION, PRODUCTION AND TRAINING

Details about mushroom cultivation, production and training like period of mushroom cultivation, attending any training programmes, duration of training programmes, place for mushroom cultivation, quantity of mushroom from one harvest, number of times of harvesting, types of mushroom cultivated, price per kilogram of mushroom, profitability of mushroom cultivation and income from mushroom cultivation was assessed using an appropriate questionnaire.

4.5.1. Period of Mushroom Cultivation

From the survey, it was revealed that the majority of the respondents i.e., about fifty six per cent were cultivating mushroom from more than 2 years. About twenty four per cent of respondents were doing mushroom cultivation up to 2 years and twenty per cent of respondents were cultivating mushroom up to 1 year.

4.5.2. Details Regarding Training Programmes on Mushroom Cultivation

Table 17, depicts that the majority of the respondents (Ninety six per cent) have attended training classes for mushroom cultivation and only four per cent of them were doing mushroom cultivation without attending any training classes.

The period of training classes was seen to range from one day to more than three days. Table 17 reveals that sixty eight per cent of the respondents attended training classes for mushroom cultivation for a time period of 2 - 3 days and about twenty eight per cent of the respondents attended training classes for a time period of more than 3 days.

4.5.3. Area for Mushroom Cultivation

It can be observed from Table 17 that about forty per cent of respondents were cultivating mushrooms in nearby home shelters and about thirty six per cent

of the respondents were doing mushroom cultivation in house itself and twenty four per cent of the respondents were using particular buildings.

4.5.4. Yield Obtained from One Harvest

From Table 17, it can be seen that majority of the respondents (ninety two per cent) were producing mushroom about 1 - 10kg from each harvest and the remaining eight per cent of respondents were producing 40 - 50kg per harvest

This table also shows that seventy six per cent of the respondents were harvesting 10 - 20 times in a year and sixteen per cent of them were harvesting more than thirty times in a year. 20 - 30 times of harvesting was done in a year by eight per cent of the respondents

4.5.5. Type of Mushrooms Cultivated by the Respondents

Sixty percent of the respondents were cultivating both oyster and milky mushrooms. Twenty eight per cent of them were producing only oyster mushrooms and about twelve per cent of the respondents were producing only milky mushrooms.

4.5.6. Price of Mushrooms

Table 17 reveals that all of the respondents (i.e., hundred per cent) were selling their mushrooms for rupees ranging from 200 - 300Rs for 1 kg.

4.5.7. Profitability of Mushroom Cultivation

In the case of profitability of mushroom cultivation, it was seen that all of the respondents (i.e., 100 per cent) were of the opinion that mushroom cultivation is profitable.

4.5.8. Income from Mushroom Cultivation

From Table 17, it is also revealed that about forty per cent of the respondents had an income of above Rs.4000 from mushroom cultivation. Eight

per cent of the respondents had an income ranging from Rs.3000 - 4000. Thirty two per cent of the respondents had an income ranging from Rs.2000 - 3000 and the remaining twenty per cent of the respondents belonging to the income group of Rs.1000 - 2000.

Table 17. Distribution of Respondents Based on Mushroom Cultivation, Production and Training

Variables	Category	Number of respondents	Percentage
Period of mushroom cultivation	1 year	5	20
	2 years	6	24
	More than 2 years	14	56
Whether participants have undergone training	Yes	24	96
	No	1	4
Duration of training	1 day	-	-
	2 - 3 days	17	68
	> 3 days	7	28
Area for mushroom cultivation	Particular buildings	6	24
	In the home	9	36
	Nearby home	10	40
		-	-

	Others		
Quantity of mushroom in one harvest	1 - 10 kg	23	92
	20 - 30 kg	-	-
	40 - 50 kg	2	8
Total number of harvests in a year	10 - 20	19	76
	20 - 30	2	8
	Above 30	4	16
Type of mushroom cultivated by the respondents	Oyster mushrooms	7	28
	Milky mushrooms	3	12
	Both oyster and milky mushrooms	15	60
Price of mushrooms (For 1 kg)	250 – 350	25	100
Profitability of mushroom cultivation	Yes	25	100
Income from mushroom cultivation/ month	1000 - 2000	5	20
	2000 - 3000	8	32

	3000 - 4000	2	8
	Above 4000	10	40

4.6. DETAILS REGARDING MARKETING TRENDS OF FRESH MUSHROOMS

Details regarding marketing of fresh mushrooms including mode of marketing and methods used for selling were assessed.

4.6.1. Mode of Marketing

Table 18, shows that about fifty six per cent of the respondents were marketing their produce at nearby houses and thirty two per cent of them were marketing mushrooms through shops. Remaining twelve per cent of the respondents were marketing through offices.

4.6.2. Method used for Selling Fresh Mushrooms

From Table 18, it is depicted that about seventy six per cent of the respondents were using direct method for selling the produce and sixteen per cent of them were selling the mushrooms through agents. Also eight per cent of the respondents were depending on shops for selling their mushrooms.

Table 18. Distribution of respondents based on marketing of fresh mushrooms

Variables	Category	Number of respondents	Percentage
Mode of marketing	Shops	8	32
	Melas	-	-
	Krishibhavan	3	12
	Through Kudumbasree	-	-
	Door to door sales	14	56
Methods used for selling	Directly	19	76
	Through agents	4	16
	Nearby shops	2	8
	Government agencies	-	-

4.7. DETAILS REGARDING SPOILAGE OF MUSHROOMS

Details regarding spoilage of fresh mushrooms during storage after harvesting and amount of mushroom spoiled during each harvesting were assessed.

4.7.1. Marketing of Mushroom on the Harvested Day

From Table 19, it is found that the majority of respondents (i.e., Ninety six per cent) were not able to sell the mushroom completely on the harvested day itself and about four per cent only were able to sell these mushroom on the harvested day itself.

4.7.2. Occurrence of Spoilage during Storage

As shown in table 19, about ninety two per cent of the respondents reported spoilage in mushrooms during storage after harvesting. Eight per cent of the respondents did not experience the problem of spoilage in mushrooms.

4.7.3. Amount of Mushroom Spoilt

Table 19 shows that the majority of respondents (i.e., Fifty six per cent) reported spoilage of about 1000 - 2000gm of mushroom per harvesting and twenty eight per cent of the respondents were having a loss of 2000 - 3000gm and about eight per cent of the respondents were having spoilage of about more than 3000gm of mushroom.

Table 19. Details regarding the spoilage of mushrooms

Variables	Category	Number of respondents	Percentage
Marketing of mushroom on the harvested day	Yes	1	4
	No	24	96
Occurrence of spoilage during storage	Yes	23	92
	No	2	8
Amount of mushroom spoilt/ harvest	1000 - 2000gm	14	56
	2000 - 3000gm	7	28
	> 3000gm	2	8

4.8. DETAILS ON PROCESSING OF MUSHROOMS

Details regarding knowledge about processing of fresh mushroom and value added products from mushrooms made by respondents were assessed.

4.8.1. Awareness of Respondents about Value Added Mushroom Products

Table 20 shows that eighty per cent respondents were not having knowledge about value added products made from mushrooms and twenty per cent of the respondents had knowledge about mushroom value added products.

4.8.2. Value Added Products Made by the Respondents

From Table 20, it is depicted that only twenty per cent of the respondents were having knowledge and performing production of value added mushroom products. Among them, sixteen per cent were making value added products such as cutlet, bhaji, etc. and four per cent of the respondents were making dehydrated mushrooms

Table 20. Distribution of respondents based on details on processing aspects of mushroom (n=25)

Variables	Category	Number of respondents	Percentage
Awareness about value added mushroom products	Yes	5	20
	No	20	80
value added products made by the respondents	Pickle	-	-
	Cutlet, bhaji	4	16
	Dehydrated mushrooms	1	4

4.9. IMPACT ASSESSMENT OF TRAINING PROGRAMME

4.9.1. Distribution of Respondents Based on their Knowledge of Value Addition in Mushrooms

Knowledge gain of respondents was assessed by using a set of 10 closed ended questions based on value addition in mushrooms before and after the

training programme. Each question was given a unit score of one for correct answer and zero for wrong answer. The difference between pre and post test score was taken as knowledge gain of an individual. The maximum possible knowledge gain was 10.

Table 21. Gain in knowledge of the respondents (n=25)

Parameters	Mean score	't' value
Pre test	4.12	15.58**
Post test	8.84	

The mean knowledge score of the respondents before the training programme was 4.12 out of a maximum of 10. After the training programme the mean knowledge score was increased to 8.84 showing the effectiveness of the awareness programme. Result of the paired t - test shows that the gain in knowledge was significant at 1 per cent level.

4.9.2. Distribution of Respondents Based on their Attitude towards Value Addition

Change in attitude was measured using a check list of ten statements pertaining to attitude towards value addition of mushrooms before and after the training programme.

Table 22. Gain in attitude of the respondents (n=25)

Parameters	Mean score	't' value
Pre test	26.4	12.4**
Post test	43.6	

From Table 22, it can be seen that the mean score of attitude for pre test was 26.4 out of a maximum of 50 while for the post test it has increase up to 43.6. Result of the paired t - test shows that the change in attitude was significant at 1 per cent level. An estimated 't' value of 12.4 shows that training programme has a significant effect on the attitude of respondents.

4.9.3. Adoption of Value Added Mushroom Products

After two months of training programme, all the respondents were interviewed to assess the adoption of different value added products from mushroom.

Table 23. Distribution of respondents based on adoption of value added mushroom products (n=25)

Products	Number of respondents	Percentage
Mushroom chutney powder	18	72
Mushroom soup powder	10	40
Mushroom pickle	22	88
Mushroom wafers	10	40
Dehydrated mushrooms	15	60
Nil	3	12

Majority of the respondents produced mushroom pickle (i.e., Eighty eight per cent) and seventy two per cent of the respondents made mushroom chutney powder. Forty per cent of respondents prepared mushroom soup powder and mushroom wafers. About sixty per cent of the respondents preferred making dehydrated mushrooms. About twelve per cent of the respondents do not prepare any value added products from mushrooms.

4.9.4. Marketing of Value Added Mushroom Products by the Respondents

Details regarding the marketing of value added mushroom products including the sale of mushroom products and the area of marketing of these mushroom products were assessed.

Table 24. Details regarding sale of mushroom products (n=25)

Products	Number of Respondents	Percentage
Mushroom chutney powder	15	60
Mushroom soup powder	7	28
Mushroom pickle	18	72
Mushroom wafers	7	28
Dehydrated mushrooms	14	56
Nil	3	12

Table 24 shows that about seventy two per cent of respondents were selling mushroom pickle and sixty per cent of the respondents were selling mushroom chutney powder. Fifty six per cent of them were selling dehydrated mushrooms, twenty eight per cent respondents were selling mushroom soup powder and mushroom wafers. Twelve per cent of respondents were not selling any of the products.

Table 25. Distribution of respondents based on area marketing of products

Area of marketing	Number of Respondents	Percentage
Household level	16	64
Retail shops	11	44
Super markets	Nil	Nil

From Table 25, it can be found that most of the respondents (i.e., sixty four per cent) were marketing their products at the household level and forty four percent of them were selling through retail shops. None of them were selling their products in supermarkets.

4.9.5. Income Generation after Production of Processed Mushroom Products

From the above results, it is clear that after processing products with mushroom, majority of the respondents were able to sell their products at nearby homes and small retail shops at recent prices. Most of the respondents (eighty eight per cent) reported that they got satisfactory income after making these value added products. The income generation by the respondents was also assessed by assessing the profit obtained by the sale of mushroom products.

Table 26. Details regarding the profit obtained by the sale of value added products

Product (100gm)	Production cost (Rs)	Selling price (Rs)	Profit (Rs)	Profit percentage
Mushroom chutney powder	45	70	25	55
Mushroom soup powder	130	150	20	15
Mushroom pickle	52	80	28	53
Mushroom wafers	40	55	15	37
Dehydrated mushrooms	279	350	71	25

In the table 26, it is depicted that all the five mushroom products are providing a good profit. Among the products, mushroom chutney powder and mushroom pickle are having more than fifty per cent of profit (i.e., 55 and 53 per cent). Mushroom wafers are having a profit percentage of 37 per cent. Twenty five per cent profit is obtained from dehydrated mushrooms and fifteen per cent profit from mushroom soup powder.

Discussion

5. DISCUSSION

The findings of the study entitled "Empowerment of mushroom growers through technology transfer of value added products" have been statistically analysed and presented in the previous chapter. These findings with relevant research support are discussed in this chapter under the following headings.

5.1. Acceptability of value added mushroom products

5.2. Yield per cent and cost analysis of mushroom products

5.3. Shelf life quality of value added mushroom products

5.4. Personal and socio economic characteristics of the respondents

5.5. Details regarding mushroom cultivation, production and training

5.6. Details regarding marketing of fresh mushrooms

5.7. Details regarding spoilage of mushrooms

5.8. Details on processing aspects of mushrooms

5.9. Impact assessment of training programme

5.1. ACCEPTABILITY OF VALUE ADDED PRODUCTS

5.1.1. Organoleptic Evaluation of Mushroom Products

Sensory evaluation has been defined as a scientific method used to evoke, measure, analyse and interpret those responses to products as perceived through the senses of sight, smell, touch, taste and hearing (Stone and Sidel, 2002).

In the present investigation, sensory evaluation of five value added mushroom products revealed that all the products are having high acceptability. The mean score obtained for overall acceptability of these mushroom products is depicted in Figure: 1

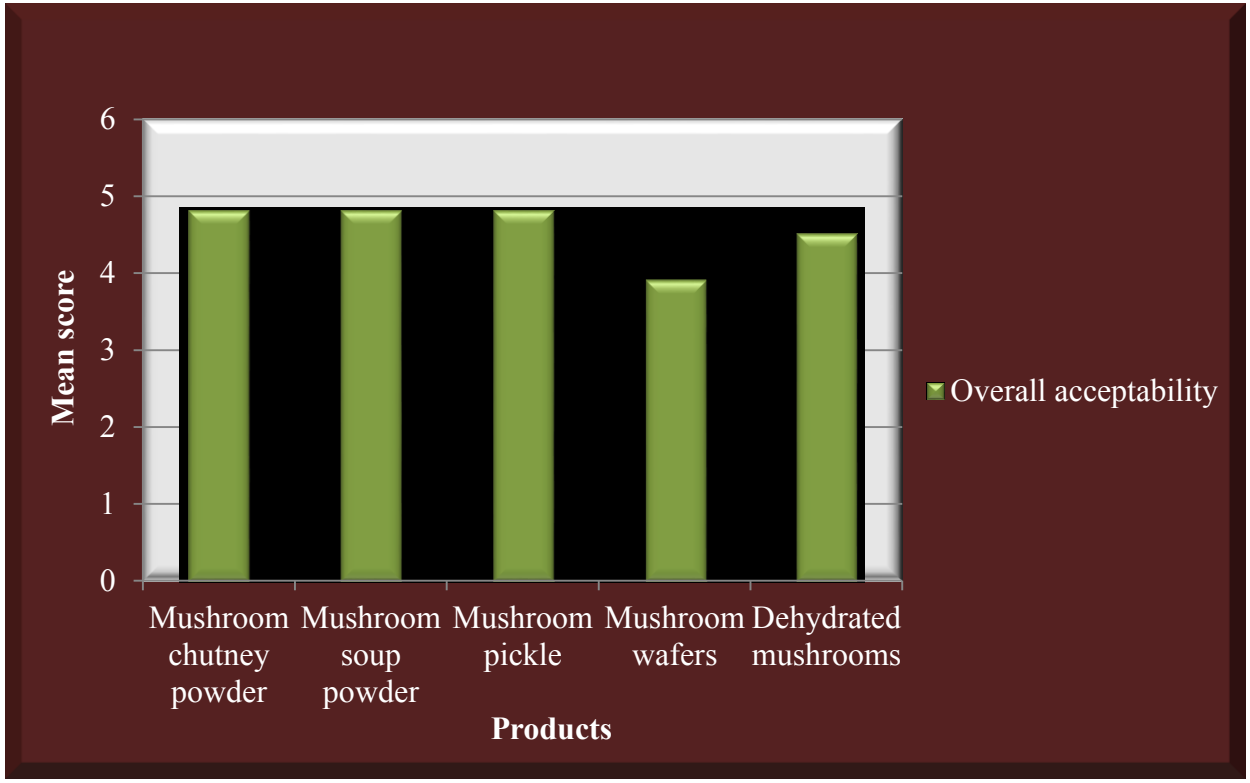


Fig: 1. Organoleptic evaluation of developed mushroom products

Dorko and Penfield (1993) stated that the aesthetic, safety, sensory characteristics and acceptability of foods are affected by colour. Bajaj *et al.* (2002) found that flavour imparts recognizable character to the food products. It is becoming increasingly evident that some form of texture measurement is highly desirable in the grading of all foods (Matz, 1962).

Kremer *et al.* (2005) reported that the characteristic flavour and texture in soups are very important in selling the soup mixes. In the present study, the mushroom soup powder also had characteristic flavour, texture and taste with an overall acceptability of 4.8. The characteristic flavour was due to the presence of ingredients like tomato, onion, cornflour, pepper powder etc in the soup mixes. Rosette *et al.* (1997) suggested that tomato was used mainly to improve flavour in soups.

Bhuiyan *et al.* (2012) suggested that higher concentration of salt gives higher acceptability for pickle. Pickles are an edible product that has been preserved and flavoured in a solution of brine and edible acid such as vinegar. Salt, vinegar and spices are commonly used in complementary action in pickling (Desrosier, 1977). In this investigation, the mean score obtained for mushroom pickle was 4.8 which showed excellent organoleptic quality. This may be due to the method involved in cooking of mushroom followed by light frying and addition of spice mix, salt and vinegar. These findings agree with the results of the study conducted by Haleem *et al*. (1996). He reported that the pickle made from cooked and fried meat with other ingredients showed great acceptability.

Wafers are also like pappads, chips or biscuits. In the present study, mushroom wafers were found to have a good organoleptic quality. Mushroom wafers were fried before given to the judges for organoleptic evaluation. The overall acceptability of mushroom wafers was 3.9 which range from fair to good. Higher recovery and lesser uptake of oil were noted while frying mushroom wafers.

Drying is an effective method of preserving edible mushroom because it preserves the mushrooms by removing enough water to inactivate the enzymes and micro-organisms (Cao *et al.*, 2003). Dried mushroom can be easily powdered and used in many different types of preparations such as soups, bakery products, culinary items etc. (Kamal and Kumar, 2014). These dehydrated mushrooms can be rehydrated by water immersion before the consumption.

In the present study, the dehydrated mushrooms were rehydrated by soaking in water for 2-3 hrs and then it was made into products like mushroom curry and evaluated organoleptically. The results showed that the acceptability of sensory characteristics of dried mushrooms ranged between good and excellent. The present findings are in agreement with the values reported for dried mushroom prepared from button mushroom (*Agaricus bisporus*) by Kar *et al*. (2004).

5.1.2. Consumer Preference of Mushroom Products

Today's consumers have increased concern regarding food safety and qualities. Consumers measure food quality using visible features such as pleasant attributes of the product and also their awareness of invisible qualities such as microbial, toxicological safety and nutritive value (Taemans, 2000). According to Anvita *et al.* (1993), most of the consumers have fairly fixed ideas and known what to expect in terms of sensory qualities of a given processed food. During the development of new food products or the reformation of existing products, the identification of changes caused by processing method or stored or by the use of new ingredients, their acceptability could be assessed by conducting preference test on a large number of consumers (Watts *et al*., 1989). Preference studies are designed to determine consumer's subjective reactions to external phenomena and their reasons for having them.

In the present investigation, all the mushroom products were found to be highly acceptable by the consumers (Figure: 2). The products like mushroom chutney powder, mushroom soup powder, mushroom pickle and dehydrated

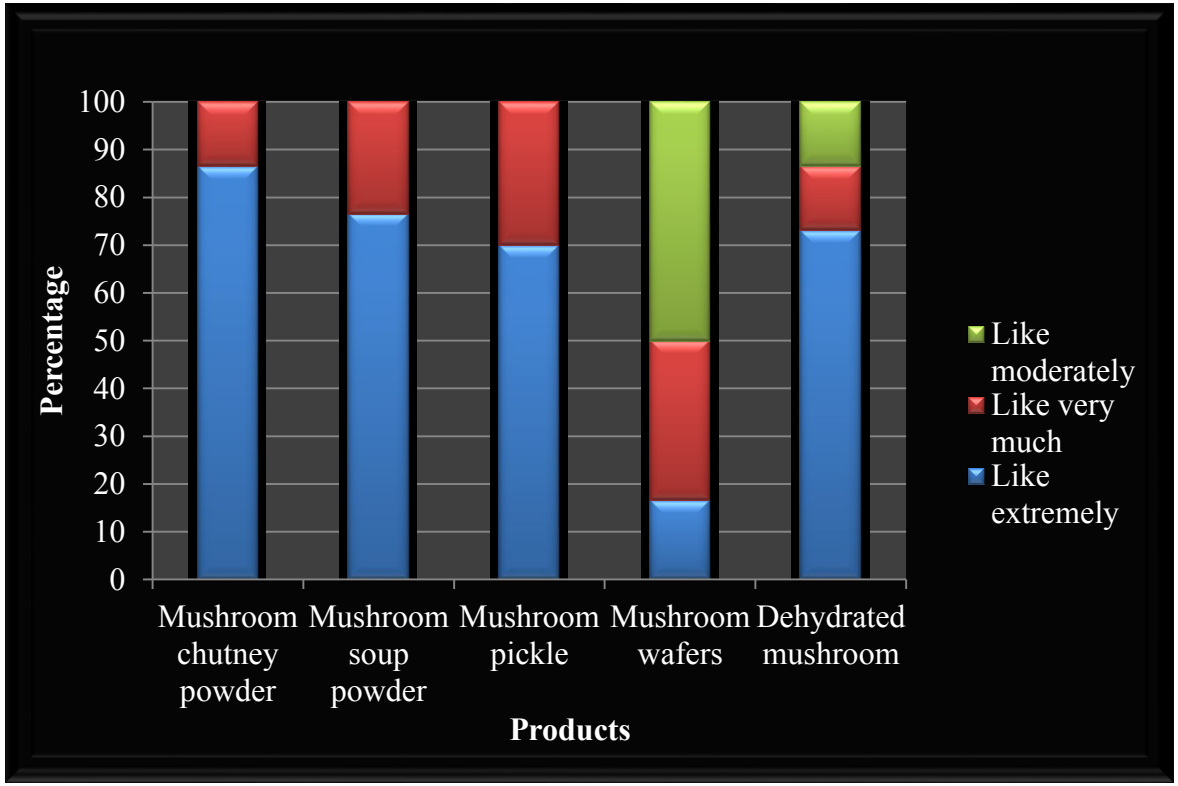


Fig: 2. Consumer preference of developed mushroom products

mushrooms were rated as highly acceptable by majority of the respondents. Mushroom wafers were moderately accepted by most of the respondents.

Value added products provide the opportunity to produce a new variety of innovative snack products. Consumer demand is increased for ready to serve convenience products with minimal processing before consumption (Chattopadhayay *et al.,* 2008).

Consumer acceptance is more for value added products than fresh mushrooms (Sharma and Vaidhya, 2011). The findings of the present study is supported by Peker and Celik (2009) who reported that in a market survey conduct in China, the value added products of mushroom mainly dehydrated mushroom was found to have more demand among the consumers.

Another study conducted by Karthikeyan (2009) found that the consumer acceptance of value added products of mushrooms like pickle and soup powder were highly acceptable and liked very much by the consumers.

5.2. YIELD PER CENT AND COST ANALYSIS OF MUSHROOM PRODUCTS

The highest yield per cent was obtained for mushroom pickle which is about 44.04 per cent. Mushroom chutney powder is having a yield of about 40.46 per cent and mushroom wafers are having 37.06 per cent of yield. The yield per cent obtained for dehydrated mushrooms and mushroom soup powder is 9.65 per cent and 9.12 per cent.

Cost benefit analysis endorses the potential to assess the cost attained for the development of a product. According to How (1990), information as accurate and up to date as possible on supply, demand and prices is essential for anyone directly involved in the business of marketing products. Hence the production cost of each item was worked out to assess the expenses incurred.

The cost of each of the mushroom products was calculated by adding the costs of ingredients used for the preparation of each product with ten per cent overhead charges needed for processing.

The price of mushroom soup powder was worked out as Rs. 13, mushroom pickle (Rs. 5.2), mushroom chutney powder (Rs. 4.5) and mushroom wafers (Rs. 4) and dehydrated mushrooms as Rs. 27/ serving.

Cost analysis of different mushroom products throws light on the possible production of nutritious, tasty and appreciable products with mushroom at a lesser cost. Thus these products catch the consumer's attention.

All these products were found to be acceptable, nutritious as well as economical when compared with similar other products in the market. These advantages could increase the likelihood of consumers buying these products.

5.3. SHELF LIFE QUALITY OF VALUE ADDED MUSHROOM PRODUCTS

The shelf life can be defined as the length of time that a package or a material in a container will remain in a sealable or acceptable condition under specified conditions of storage (Kumar, 1990). Extended shelf life is a key factor for making any food commodity more profitable and commercially available for long periods of time at the best possible quality. The producer will benefit from the longer shelf life needed to develop the market over greater distances (Akram and Kwon, 2010).

5.3.1. Organoleptic Changes of Stored Mushroom Products

Monitoring the storage behaviour in terms of sensory analysis is an easy and important method of testing the acceptability of the products. John (2002) stated that for consumers, the perceivable sensory attributes appearance, colour, flavour, texture and taste are the deciding factors for the acceptance of any food products.

According to Kramer and Twig (1970), among the various quality attributes, taste is the primary and most important one. And hence due importance to every sensory characters has to be given in assessing the organoleptic qualities.

An attempt has been made to ascertain the influence of storage on the acceptability of the five value added mushroom products. Changes in various quality attributes on these products during storage were assessed.

5.3.1.1. *Changes in the Organoleptic Qualities of Mushroom Chutney Powder during Storage*

Chutney is an important dish in Indian cuisine and they are made from fruits and vegetables or a mixture of the two, which are chopped, cooked, mixed with spices, vinegar and other ingredients. Chutneys are preserved in several ways such as using oil, vinegar or citrus juice fermentation in the presence of salt (Veerapandian *et al.*, 2014).

In the present study, findings of organoleptic evaluation indicated that there was no remarkable change in the organoleptic characteristics of mushroom chutney powder. The appearance, colour, flavour, taste and texture were seen to be good. The sensory scores of chutney powder remained within the acceptance limit throughout the storage period of four months. The overall acceptability of chutney powder ranged from 4.6 to 4.5 during the storage period. From the organoleptic point of view the mushroom chutney powder was good and safe for human consumption.

These results were in agreement with the findings of Joshi *et al.* (2000). In his study, he developed sweet chutney powder from button mushroom with good taste, attractive colour and the storage life of this product was more than one year.

Renitta *et al*. (2006) reported that the chutney powder prepared from spider conch had no spoilage during the storage period of four months in airtight containers. Jyothirmayi *et al.* (2006) developed instant raw tamarind chutney powders which also have a good shelf life of six months without any change in

sensory parameters. Muraleedharan (1980) found that the chutney powder prepared from smoked sardine fillets had no spoilage during its storage period of six months.

5.3.1.2. *Changes in the Organoleptic Qualities of Mushroom Soup Powder during Storage*

As reported by Abate and Peterson (2008), soup is a favourite comfort food and is relished by people of all age groups. Dehydrated soup mix is a convenient product due to its less volume and long storage life at ambient temperature (Rekha *et al*., 2010). Sen and Mogra (2011) reported that the cooking characteristics and acceptability of soup mix was not affected by the storage period and microbially safe for consumption.

In this study, even after four months of ambient storage, the mushroom soup powder was quite acceptable to panelists. No significant decline was noticed in colour, appearance and texture. Sensory parameters like flavour and taste did not alter and product remained acceptable throughout the storage period.

Similar study was given by Randhav and Ranote (2004) in which the soup powder prepared from *P. florida* was most acceptable and having shelf life of three months. Almost similar observations were reported by Deshpande and Tamhane (1981).

5.3.1.3. *Changes in the Organoleptic Qualities of Mushroom Pickle during Storage*

Pickling is an age old traditional method for preservation of vegetables and fruits. Pickled products are common in Indian diets and are much relished by consumers. Pickling of perishable foods in vinegar or edible oil with added salt, spices and condiments provide ready to eat products with good shelf stability at ambient temperature. Along with preservative effect pickling also helps to improve desirable characteristics like colour, flavour and texture (Das *et al*., 2007).

In this investigation, even after storage of four months at ambient temperature, the overall acceptability of mushroom pickle was rated between good and excellent. There was some negligible reduction in sensory scores from the end of third month but the extent of reduction was non-significant.

Similar decrease in overall acceptability during storage was reported earlier by Sen and Karim (2003) in rabbit pickle and Kumar and Bachhil (1993) in pork pickle. Bhuiyan (2012) also found that the colour, flavour and texture of fresh hog plum pickle were acceptable as there were no changes up to five months of storage.

5.3.1.4. *Changes in the Organoleptic Qualities of Mushroom Wafers during Storage*

Wafers also called pappads are salty and crispy. This is served as a side dish to a meal or as an appetiser or snack. The basic wafers are cooked and salted: additional varieties are manufactured using various flavourings and ingredients including seasonings, herbs, spices and artificial additives. Sometimes several dipping sauce or condiments such as diced onions/ chutneys are served with it. Raw pappads are made after rolling lentils or rice dough mixed with spices into a thin flat bread and sun drying it. Raw pappads/ wafers are served either after roasting or deep frying. Wafers are also made from potato, corn, tapioca and other cereals. Wafers are the predominant part of the snack food market in western countries.

In the present investigation, quality parameters like appearance, flavour and taste remained constant till the end of third month. Colour and texture remained unchanged till the end of second month. The overall acceptability value did not show any significant change during the four months of storage.

One of the major properties of snacks is the crispiness which is achieved during the manufacture of the product by methods such as drying, roasting or frying to reduce the level of moisture content. Retention of desirable texture (crispiness) is directly related to the moisture level in the product. Evaluation of

snack foods packed in laminated pouches and stored for 90 days was established to have acceptable colour, taste, texture, flavour and crispness to the panel members (Shukla *et al*., 2013).

Arumuganathan *et al.* (2005) reported that the value addition of oyster mushrooms into chips could provide solution as long term storage of mushroom up to three months of storage without affecting the organoleptic quality of the product. Good quality crunchy oyster mushroom biscuits which can be comparable with commercially available biscuits in terms of appearance and taste were successfully prepared and it also showed good storage stability (Wakchaure *et al.,* 2010).

5.3.1.5. *Changes in the Organoleptic Qualities of Dehydrated Mushroom during Storage*

Drying is a very common method for small, medium and industrial scale preservation of fruits and vegetables. Therefore there has always been a need to go for a process that could give a high quality product in appearance, texture and permits a longer shelf life (Kar *et al.,* 2004).

In this study, the fresh mushrooms were blanched in 1 per cent citric acid solution to enhance the colour of dried mushrooms. Deshpande and Tamhane (1981) reported that water blanching for 3 minutes was sufficient to inactivate the polyphenoloxidase enzyme which causes browning during drying of the mushrooms. Steeping of water blanched mushroom in 1% KMS along with 0.2% citric acid before drying improved colour, texture and reconstitution properties.

In this investigation sensory attributes of dehydrated mushrooms were not much affected by the storage period and showed good to excellent acceptability scores till the end of fourth month. Before sensory evaluation, the dehydrated mushrooms were rehydrated and made into mushroom curry. It was noted that the curry prepared was very good and having superior reconstitution properties. This was supported by Rai *et al.* (2004) who reported that the mushroom curry

prepared from dried oyster and button mushroom after its rehydration is having high sensory quality.

Drying temperature also influences quality of final dried products. Mushrooms dried at higher temperature may lose texture, flavour and even colour along with reduced rehydration quality (Kamal and Kumar, 2014).

5.3.2. Chemical changes of stored mushroom products

Stability of the original quality of any processed food product is of paramount importance during storage and it should be checked to detect the acceptability of the product. Sharma (2006) is of the opinion that chemical estimation of food products is a useful criterion to judge the quality. Lesser or higher amount of certain chemicals in food make them acceptable or non-acceptable. Chemical changes of the developed products was checked by analysing the moisture content, acidity, pH and peroxide value of the products stored in standing pouches for a period of four months under ambient conditions.

5.3.2.1. *Chemical Changes in Mushroom Chutney Powder*

Acidity is measured by the number of five hydrogen ions available in the foods and it causes a sour taste (Shi and Maguer, 2000). From the result obtained it was found that acidity of mushroom chutney powder was observed to have only a slight increase from 0.46 - 0.48 per cent over a period of four months. Statistically no significant difference was noted during the entire storage period. Variation in acidity level in products may be due to changes in the concentration of organic acid present in the ingredients. Sethi (1985) suggested that the increase in acidity during storage may be due to the formation of organic acid by ascorbic acid degradation.

Increase in acidity during storage was reported in flaxseed chutney powder by Prabhakara *et al.* (2013). Veerapandian *et al.* (2014) has also reported the similar trend.

Moisture is one of the important parameter which determines the shelf life quality of any food product. Most stored products are considered to be safe at particular moisture content and low moisture is highly important for longer storage period (Shanker, 1993). In the present study, the moisture content of stored mushroom chutney powder was found to range between 2.74 per cent to 2.86 per cent and the variation in moisture was non-significant during the storage period. Increase of moisture content might be due to the hydrolysis of carbohydrate, protein and fat. Also this could have happened due to permeability of packaging material.

The similar kind of results has been reported by Rao *et al.* (2008) and according to him the chutney powder made from raw mango packed in polyethylene pouches were non hygroscopic and stable at room temperature up to six months. He also reported that the critical moisture content of chutney powder is 16 per cent which equilibrated at 71 per cent relative humidity. The results of this present study are also in accordance with Mishra *et al.* (2011).

The pH of the mushroom chutney powder was good till the end of the storage period. As per the data, the pH showed a slight decline during storage and it ranged from 5.1 to 5.0. Statistical analysis of the data revealed that there was no significant difference between consecutive months.

The decreased pH value is directly related to the increase in acidity and thus it will also help to prevent the growth of micro organisms. The result of present study are in accordance with the findings of Jyothirmayi *et al.* (2006) who reported a decrease in pH in tamarind chutney powder during storage.

The precooked dehydrated instant foods are highly susceptible to oxidation leading to the development of peroxides which causes undesirable flavour. The nature of auto oxidation degradation depends on the extent of unsaturation of lipids (Sharma, 2006).

In the present experiment peroxide value of mushroom chutney powder was seen to be very less and it showed a very negligible increase during the storage

period (between 0.166 - 0.283meq per 100gm). This is in agreement with the findings of Renitta *et al*. (2006). According to her chutney powder made from spider conch is having a peroxide value similar to the above results and these were found to increase slowly and did not exceed the permissible limits till the end of storage period.

5.3.2.2. *Chemical Changes in Mushroom Soup Powder*

In the present investigation, the acidity value of mushroom soup powder has showed only a slight increase from initial level to the fourth month of storage which indicated that the acidity of the mix decreased gradually. Soup mixes with high acidity make the product free from microbes as proved by the study of Okarie *et al*. (2004).

The different ingredients such as tomato, onion were used to enrich soup mix responsible for acidity content. According to Yilmaz (2001), citric acid and malic acid are the major organic acids found in tomatoes, in addition to several other carboxylic acids, sugar acids and alicyclic acids which are responsible for the acidity content in tomato.

Nasheeda (2006) found that the banana based multipurpose convenient mix has an acidity ranging from 0.064 to 0.256 per cent during the storage period.

The periodical testing for moisture of mushroom soup powder performed only a slight upward trend in the value with the increase in storage period. Moisture increase was merely from 0.52 to 0.55 per cent. However, change in moisture content of the soup mix did not influenced the quality of the soup because the variation in moisture content was negligible.

Tilakaratne (2012) supported the above findings. According to the author, the storage period of dried soup mixture was about twelve weeks and the parameters like moisture content, water activity and colour of the dried soup mixture does not show any significant change.

pH changes in mushroom soup powder was not much noticeable as it showed only a slight increase from 4.78 to 4.6 during the storage period of four months. The pH value of the mushroom soup powder in the present study is in accordance with the values reported by Nasheeda (2006) in banana based multipurpose convenient mix.

The fluctuation of peroxide value was very low up to the fourth month of storage period. The analysed peroxide values of mushroom soup powder during storage ranged between 0.024 to 0.026meq/100gm and this is in accordance with results obtained by other workers in relevant studies.

Shruti (2005) reported that peroxide value of malted health drink mix as 0.016 meq and spiced health mix (0.089 meq/ 100gm) remained unaffected during the storage period. Banerjee and Tripathi (2000) reported that colocasia mash mix reported to have peroxide value from nil to 1.07meq/ 100gm when stored for four months.

5.3.2.3. *Chemical Changes in Mushroom Pickle*

Increasing the acidity of foods, either through fermentation or the addition of weak acids, has been used as a preservation method since ancient times. Organic acids are more effective preservatives in undissociated state (Dziezak, 1986).

In the present study, at zero hour, the titratable acidity of mushroom pickle was 0.763 per cent which slightly increased to 0.783 per cent with storage. This increase in titratable acidity might be due to interaction of organic acids either with basic minerals of the product or with mushroom components with time (Kumar and Ray, 2007). Pal (1990) reported that the titratable acidity of pickle was not affected by packaging material. These changes in acidity are in line with those reported earlier by Pal and Agnihotri (1994) and he found that there was a significant increase in titratable acidity of chevon pickle during the storage period of six months.

The change in moisture was observed to be slightly decreased with the increase in storage period and it ranged from 44.48 per cent to 44.36 per cent. This finding has been supported by the similar work done by Kumar and Ray (2007). According to him there was a significant decrease in moisture content of button mushroom pickles during storage of one year. Sachdev *et al*. (1992) also studied storage stability of different types meat pickle and observed a constant decrease in the moisture content of these pickled meat during storage.

In the present investigation, the pH of mushroom pickle showed a slight decrease with increase in storage period. The initial value of pH in mushroom pickle was 3.96 which changed to 3.7. In a study, Pal and Agnihotri (1994) reported that a significant decrease was observed in pH of both meat and paneer pickle.

pH of pickled chicken meat reduced gradually from 5.81 on zero days to 4.66 on 80th day (Reddy and Rao, 1996). Equivalent to the present study, Khanna *et al.* (2004) reported that reduction in pH of chicken pickle from 4.9 to 4.3 and 4.2 in PET jar and laminated pouches was observed while titratable acidity was increased from 1 to 1.1 per cent at the end of six months.

Peroxide changes in mushroom pickle were not much noticeable as it was only a slight increase from 0.044 to 0.046meq/100gm. The result of the present study is in confirmity with Puttarajappa *et al*. (1996). According to him, there was a progressive increase in free fatty acid and peroxide value of chicken pickle for a storage period of 180 days.

5.3.2.4. *Chemical Changes in Mushroom Wafers*

From the result obtained it was found that acidity of mushroom wafers was observed to have only a slight increase from 0.63 - 0.76 per cent over a period of four months. Statistically no significant difference was not during the entire storage period.

The periodical testing for moisture of mushroom wafers performed slight upward trend in the value with the increase in storage period. Moisture increase was from 1.2 to 1.33 per cent.

The moisture content affects not only the texture of mushroom wafers, which become soggy, but also the rate of oxidation. At higher or lower permissible level of moisture, the rate of oxidation increased. In the present study, the moisture content of mushroom wafers is within the permissible levels. Low moisture is highly important for the longer storage period (Shankar, 1993).

Midhila (2013) reported that the moisture content of the RTC products from banana blossom was found to increase gradually during the storage period. But the increase in moisture content did not influence the quality of the developed RTC product because the increase in moisture content was negligible.

The pH of the mushroom wafers did not change much till the end of the storage period. As per the data, pH was showed a slight decline during storage and it ranged from 4.9 to 4.7. Statistical analysis of the data revealed that there was no significant difference between consecutive months. These analysed values are in agreement with the levels reported for biscuits prepared from oyster mushroom by Desayi (2012).

The fluctuation of peroxide value was very low up to the fourth month of storage period. The analysed peroxide values of mushroom wafers during storage ranged between 0.012 to 0.015meq/100gm. The chemical composition of mushroom wafers in the present study is in accordance with the values reported by Cheman *et al*. (2007) in potato chips.

5.3.2.5. *Chemical Changes in Dehydrated Mushrooms*

Drying process plays an important role in the preservation of agricultural products. It enhances the shelf life and reduces water activity (Waewsak *et al.,* 2006).

In the present study, there were not much variations in acidity observed during the four months of storage period. The mean value of acidity ranged from 0.327 per cent to 0.30 per cent. The above analysed values are in agreement with the levels reported for dried mushrooms prepared from paddy straw mushrooms by Deshpande and Tamhane (1981).

The fluctuation of moisture of dehydrated moisture was very low up to the fourth month of storage. It was found that the moisture at zero hour was 2.43 per cent and 2.7 per cent at the end of fourth month which shows only a slight increase and it was under the permissible limits.

In this study the dehydrated mushroom were well stored in polypropylene pouches which also help to slow down the increase in moisture content. Suguna *et al.* (1995) reported that dried mushrooms are highly hygroscopic and are apt to absorb moisture from the air, so they should be properly stored. If the moisture content of the mushroom reaches about 20 per cent, insects and moulds will infest the mushrooms. Therefore the dried mushroom should be kept in a dry, cool and dark place. Naik *et al.* (2005) also reported that relative humidity will also helps in moisture absorption.

A study conducted by Sharma (2002) reported that the dried products prepared from apricot, plum and peach fruits were packed in laminated pouches and stored up to six months at ambient temperature. It was revealed that there was a non significant increase in moisture at the end of six months.

Mean values obtained for pH during the storage period of four months showed only a slight increase from 4.63 per cent to 4.71 per cent. Studies on the chemical characteristics of dried mushroom by Deshpande and Tamhane (1981) indicated an increase in pH on storage.

In the present experiment, peroxide value was not observed up to the second month of storage. After the end of second month an insignificant level (0.013 meq/ 100gm) was observed in dehydrated mushrooms. This was in agreement with the findings of Kumar and Sreenarayanan (2000). According to them, the

peroxide value was not observed up to the end of third month of storage and after that it was observed in a negligible level.

5.3.3. Microbial Population of the Mushroom Products

Microbial quality is one of the most critical quality parameters in a dynamic system such as food. There are different threats in food quality originating from microbial sources. Khan *et al.* (2002) stressed the need of microbiological safety of foods. Spoilage causing organisms are responsible for the development of an odd flavour and off taste that leads to economic loss (Rao, 1998).

In this investigation, the five mushroom products did not show any microbial growth during the storage period. The microbial examination were done initially and at an interval of one month up to four months by serial dilution of the products using pour plating technique. According to microbial examination of mushroom soup powder, mushroom pickle and dehydrated mushrooms, no activity was observed up to four months of storage which confirmed the successful storage behaviour and shelf life span of these three products. The same results were obtained by Pal and Agnihotri (1994) in chevon pickle, Tilakaratne (2012) in soup mixture and Prabhakara *et al.* (2013) in flaxseed chutney powder.

At the end of fourth month, yeast colonies were found in mushroom chutney powder ($1*10^{-5}$ cfu/gm) and mushroom wafers ($1*1\ 0^{-4}$ cfu/gm). 10 micro-organisms/g is considered as the total plate count limit of acceptability (Ozogul *et al.,* 2005). The products in the present study had microbial count within the limit of acceptability throughout the storage period.

Mushroom products did not contain E-coli, bacteria, moulds, salmonella and it was not detected throughout the storage period because the product samples were steam cooked before drying and processing. A similar result was reported by White (1989).

According to Chattopadhay *et al.* (2008), dry foods owe to their durability of storage but get rapidly attack by moulds and bacteria when exposed to moist air

with subsequent absorption of water and hence good packaging is essential to retain the original quality. In the present study, all the products were sealed in polypropylene pouches under hygienic conditions which showed good results during storage. This was in line with the findings of Saritha and Patterson (2014).

The results of microbiological analysis reveal that mushroom products showed storage stability at ambient conditions for a storage period of four months. Micro organisms responsible for the spoilage of processed food products were found to be absent in all the five mushroom products indicating that they were safe for consumption during the entire period of storage.

5.4. PERSONAL AND SOCIO ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

In the present study, the personal characteristics of the respondents studied comprised of age, sex, religion, type of family, education, occupation and family income. The result revealed that majority of the respondents (forty eight per cent) belonged to the middle age group between 30-40 years and 32 per cent of respondents belonged to the age group between 40-50 years. The study is supported by Mishra (2008) who opined that the majority of the farm women engaged in mushroom cultivation were within the age group of 36-45 years.

In the present investigation, most of the respondents (80 per cent) were female and only 20 per cent of them were males. Mushroom cultivation is basically an indoor activity & can be effectively managed by women. This is supported by another study conducted by Donatha (2013). According to his study, the majority of the respondents who cultivating mushrooms were women rather than men.

On assessing the social background of the respondents, it was found that sixty per cent of the respondents were Hindus and forty per cent of them were Christians. As per the data from GOK State Planning Board (2013), Hindus comprises 65 per cent of the population, Christian are about 20 per cent of the population and Muslims are about 15 per cent.

Sheethal (2011) has reported that family is a complex and dynamic institution in India. Joint family is now slowly giving way to nuclear families. In the present study, it was found that 92 per cent of the respondents were from nuclear type families. It is observed that the concept of nuclear family is becoming more common and joint family system is declining. Similar reports have been given by Renjini (2008) and Sheethal (2011) in their studies done in Thiruvananthapuram district. Nuclear family has become a prevalent norm in Kerala as reported by Bulliyya *et al.* (2002).

According to the GOK State Planning Board (2013), Kerala is the most literate state in India with a literacy rate of 91 per cent of population. The educational status is an important aspect, which influences the family members outlook towards life and determines the quality of life of the members. Assessment of family educational status of the respondents in the present study revealed that 40 per cent of the respondents had acquired BA/ BSc degree. Thirty six per cent of them had S.S.L.C and twenty per cent had education up to pre degree. Four per cent of the respondents has acquired MA/ MSc. The high education status of the respondents in a way reflects a typical picture of the kerala population with its high literacy levels. The study also found that none of the respondents were illiterate. National Family Health Survey (2005-06) also has reported that only four per cent of the population in kerala were found to be illiterates.

Apart from mushroom cultivation, occupational status of the respondents revealed that majority of the respondents (56 per cent) were housewives and for them this is the main source of income. It was also observed that 24 per cent were engaged in agriculture and cattle or poultry rearing. Twelve per cent were employed in private sector and eight per cent were employed in government sector. For these respondents mushroom cultivation is an additional source of income.

Family income is considered as an important determinant, since it determines the family status and socio economic position in the society to which they belong. In the case of family income considerable percentage that is, 48 per cent of the respondents belonged to an income category with a monthly income ranging from Rs. 10,000 - 15,000; forty per cent of the respondents belonged to the income range of rupees less than 10,000 while twelve per cent of the respondents belonged to income group of more than 15,000. Based on classification of HUDCO (2000), thirty per cent were below poverty line, 40.1 per cent belonged to low income group.

5.5. DETAILS REGARDING MUSHROOM CULTIVATION, PRODUCTION AND TRAINING

The present study has been designed with the aim to empower mushroom growers through value addition of mushroom. Twenty five respondents who are involved in mushroom cultivation were selected for the study and details regarding their cultivation, production and training were assessed.

Among several income generating activities like dairy and poultry industries, mushroom cultivation also has a new opportunity of earning and has become most popular income generating activity among a good number of landless farmers and unemployed people. Alom and Bari (2010) reported that mushroom production is labour and management intensive which takes a considerable amount of knowledge, research, planning and capital investment to set up a production system. In the present study, 56 per cent of the respondents were cultivating mushrooms up to a period of two years. Twenty four per cent were engaged in mushroom cultivation more than two years and twenty per cent of the respondents were cultivating mushrooms up to a period of one year.

Majority (96 per cent) of the respondents started mushroom cultivation after attending training on mushroom cultivation. Elaine and Nair (2009) reported that the most effective way to impart skills to the potential mushroom growers is to teach the fundamental aspects of the mushroom farming system through hands on

training. Additional training and support can enable cultivation by using the information to their advantage. The present study reveals that most of the respondents (68 per cent) have undergone training of 2-3 days duration and about 28 per cent of the respondents have undergone training of more than three days duration.

Using agricultural waste mushroom can be produced by small, landless and marginal farmers inside the house. In the present study, it was revealed that forty per cent of the respondents were cultivating mushrooms nearby home and thirty six per cent of them were doing mushroom cultivation in the home itself. Twenty four per cent of the respondents were using particular buildings. According to Sharma and Dhar (2010), land requirement for mushroom cultivation is minimum and any spare room of the house can be converted into a mushroom growing room or a hut built on a piece of land can also be used for this purpose.

The harvest of mushrooms mainly depends upon different season. Availability of mushroom is high in certain periods and also there will be non availability of mushrooms during some periods. Therefore it creates an irregular supply of the output in the market (Chang, 1996). In this study, majority of the respondents (ninety two per cent) were cultivating 1-10 kg of mushroom in one harvest and eight per cent of the respondents obtained a yield of about 40-50 kg of mushrooms in one harvest. Most of the respondents (seventy six per cent) were harvesting mushrooms 10-20 times in a year. Sixteen per cent of the respondents were harvesting more than 30 times/ year and eight per cent were harvesting 20-30 times/ year.

According to (Borah *et al.,* 2010), oyster mushroom is the most widely cultivated mushroom in India owing to its simple cultivation technology, low production cost and its adaptability. The cultivation method of milky mushroom is almost similar to that of oyster mushroom. The areas where these mushrooms are popularly grown are Orissa, Maharashtra, Tamil Nadu, Kerala, Andhra Pradesh and Karnataka. In the present study, oyster and milky mushrooms are the

two types of mushrooms cultivated by majority (60 per cent) of the respondents. Twenty eight per cent of the respondents were cultivating oyster mushroom alone and twelve per cent were cultivating milky mushroom alone. Introduction and cultivation of the tropical mushrooms like oyster, paddy straw and milky mushrooms have brought in much needed diversification in the mushroom portfolio of the country.

All the respondents were selling fresh mushrooms at a rate of Rs.250-350/ kg and all of them were on the opinion that they are getting enough profit from mushroom cultivation. Mushroom cultivation is a highly profitable venture and an important occupation which can provide livelihood opportunities for the rural poor. It is possible to make a good profit by investing a small amount of capital and labour in mushroom cultivation. Assessment of income from mushroom cultivation in the present study revealed that 40 per cent of the respondents obtained more than 4000 rupees per month, 32 per cent of them obtained Rs.2000-3000/ month, 20 per cent of the respondents obtained Rs.1000-2000/ month and 8 per cent were obtained Rs.3000-4000/ month.

According to Sahu (2012), in the rural area of Pathanamthitta, majority of women are engaged in mushroom cultivation and it was found out that they were getting good profit by cultivating mushroom which improved their livelihood.

5.6. DETAILS REGARDING MARKETING TRENDS OF FRESH MUSHROOMS

With regard to mode of marketing and methods used for selling, it was found that about fifty six per cent of the respondents were marketing mushrooms by door to door sales and thirty two per cent of the respondents marketed them through shops. Twelve per cent of the respondents were marketing through krishibhavan.

According to Robert (2010), fresh mushrooms are usually marketed to whole sellers, re-packers, or grocery store produce buyers. Larger volume growers generally market their mushrooms through in-house sales agents and distribute mushrooms through company owned or leased trucks. Smaller-volume fresh mushroom growers most often sell directly or to an independent wholesaler or other retailers. In the present study, it was reported that seventy six per cent of the respondents were selling directly, sixteen per cent through agents and eight per cent through shops.

5.7. DETAILS REGARDING SPOILAGE OF MUSHROOMS

Martin and Ronan (1998) reported that all fresh mushrooms are prone to spoilage. Fresh mushrooms have a shorter shelf life than most ready to use vegetables because their respiration rate is rapid and they have no barrier to protect them from water loss or from microbial attack.

Details about spoilage of mushrooms studied showed that majority (96 per cent) of the respondents were not able to market their produced mushroom on the harvested day itself. In a study conducted by Chang (2008), it was reported that the high production of mushrooms during the peak season results in greater loss and spoilage of mushrooms due to improper marketing.

In the present study, most of the respondents (92 per cent) were facing spoilage in mushroom during storage after harvest. Among this, fifty six per cent of the respondents were facing a loss of 1000-2000 gm of mushroom/ harvest, twenty eight per cent of them were facing a loss of 2000-3000 gm of mushroom/ harvest and eight per cent of the respondents were facing a loss of more than 3000gm/harvest.

When a large quantity of mushroom is harvested per day, then its marketing becomes a major problem. Since mushroom is an easily perishable commodity, growers in village areas have no access to local markets where they can easily dispose off their produce. Because of this farmers are forced to sell mushroom at

the end of the day for a low price which will indirectly affect their economic status.

5.8. DETAILS ON PROCESSING OF MUSHROOMS

The basic aim of processing is to increase the quality and shelf life without changing their nutritive and sensory quality. The primary reason for processing vegetables is to extend the shelf life beyond the period when there is plenty into the bend or away of season period. Usually when there is excess of a product, supply outweighs demand and the product fetches less money. Adding value to the original crop helps the farmers not only to overcome the spoilage and losses, but also fetches high returns due to the newly added technology.

In the present study, eighty per cent of the respondents were not having knowledge about value added products made from mushrooms and only twenty per cent of the respondents were have knowledge about mushroom value added products. Majority of respondents did not have any idea about value addition prior to the training programme and this is mainly due to the inadequate knowledge of mushroom growers about post harvest technologies.

Only twenty per cent of the respondents were having knowledge and performing production of value added mushroom products. Among them, sixteen per cent were making value added products such as cutlet, bhaji which is having only a short shelf life (one or two days) and four per cent of the respondents were making dehydrated mushrooms. And it is also reported that this was done mainly for reducing the loss of fresh mushrooms. Considerable amount of unmarketable and physically damaged mushrooms that are without infection can be converted into value added products by processing.

5.9. IMPACT ASSESSMENT OF TRAINING PROGRAMME

It was revealed that majority of the selected respondents reported low knowledge, attitude and adoption of mushroom processing and value addition prior to the conduct of training programme. The present study is an endeavour to

empower the mushroom growers through a training programme of value added products. The training programme was designed including several information about processing and value addition in mushrooms and nutritional and economic needs of value added products. Method demonstration of five mushroom products was conducted among the respondents, a cooking competition was also held among the respondents so as to create interest and more awareness among them. Finally, evaluation was conducted to find out the change in knowledge and attitude of the respondents towards value addition, as well as level of production of value added products by the respondents. Their income generation was evaluated after a period of two months after the training programme was conducted.

5.9.1. Change in Knowledge of the Respondents

A knowledge test was administered to the participants before exposing them to the training programme and also after the exposure to measure increase in their knowledge levels. Most of the farmers are having inadequate knowledge about post harvest technologies and preservation technologies. Due to this there is a loss in mushroom production. Hence through various training programmes the knowledge of these mushroom growers with respect to production as well as preservation can be increased (Nichols, 1985). In this study also, most of them were not aware of value addition in mushroom prior to training. The possible reasons were less awareness of trainees, lack of interest due to limitation of funds for investment, short training programmes which were not sufficient for gathering adequate knowledge and no follow up activities of conducted programmes.

In the present study, the respondents were exposed to various aspects of value addition in mushrooms during three days of training programme. The present study has indicated that the knowledge was increased after the training programme. This may be because of the effectiveness of the programme. The mean score obtained by the respondents for pre knowledge was 4.12 out of a maximum 10, showing the lack of adequate knowledge about value addition of

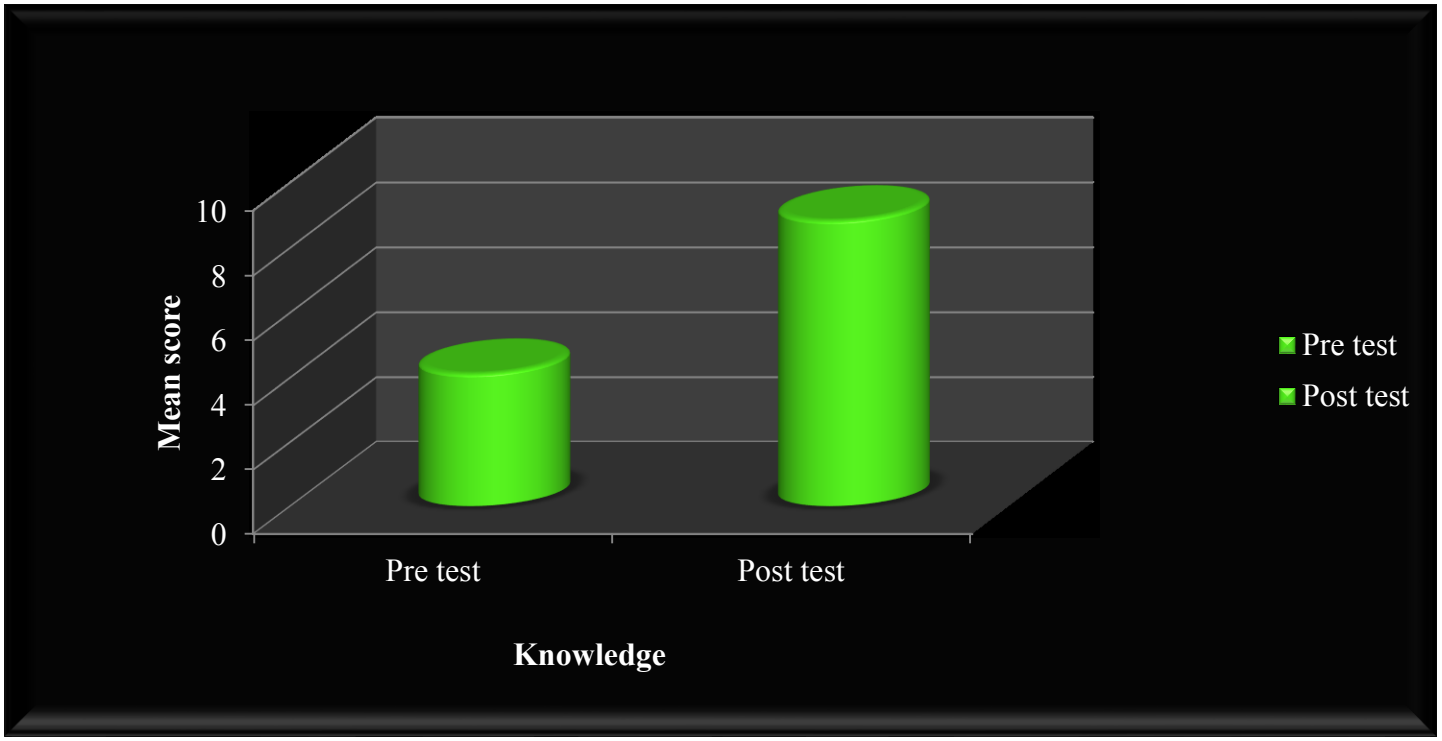


Fig: 3. Gain in knowledge of the respondents

mushroom among the respondents. After the training programme was conducted, the post test revealed that the mean knowledge score was 8.84 out of 10. From the score obtained for post test it is clear that there was significant gain in their knowledge (Figure: 3). The respondents were also exposed to prepare several mushroom products which enabled them to understand the significance of value addition. The respondents were given a hand out (booklet) on recipies of value added mushroom products for further guidance and follow - up.

In a study conducted by Prita (2001) in Dharwad district it was found that training given to the mushroom growers increased their knowledge and attitude towards mushroom production and preservation. It is also resulted in participation of more number of mushroom growers in mushroom preservation.

Earlier study conducted by Razeena (2000) has proven that the actual impact of educational programme was the adoption of the gained knowledge and it was found that teaching had significant effect on the adoption of good practices. Several studies have shown that nutrition education and intervention increases the nutritional knowledge of the respondents (Morris *et al.,* 2002; Razeena, 2000).

5.9.2. Change in Attitude of the Respondents

Attitudes are necessary precursors to changing behaviors, as it determines a person's intention to perform (Holland *et al.,* 2002).

An attitude test was administered to the respondents before and immediately after the training programme to measure their attitude towards value addition. The pre test revealed that the mean attitude score was only 26.4 out of a maximum 50 showing a poor attitude of the respondents towards value addition in mushrooms. The post test conducted immediately after the intervention programme revealed that the mean score was 43.6 showing the impact of the programme on the attitude of the respondents (Figure: 4). From the score obtained for the post test it is clear that the training had significant influence in changing wrong attitudes and wrong beliefs of the respondents.

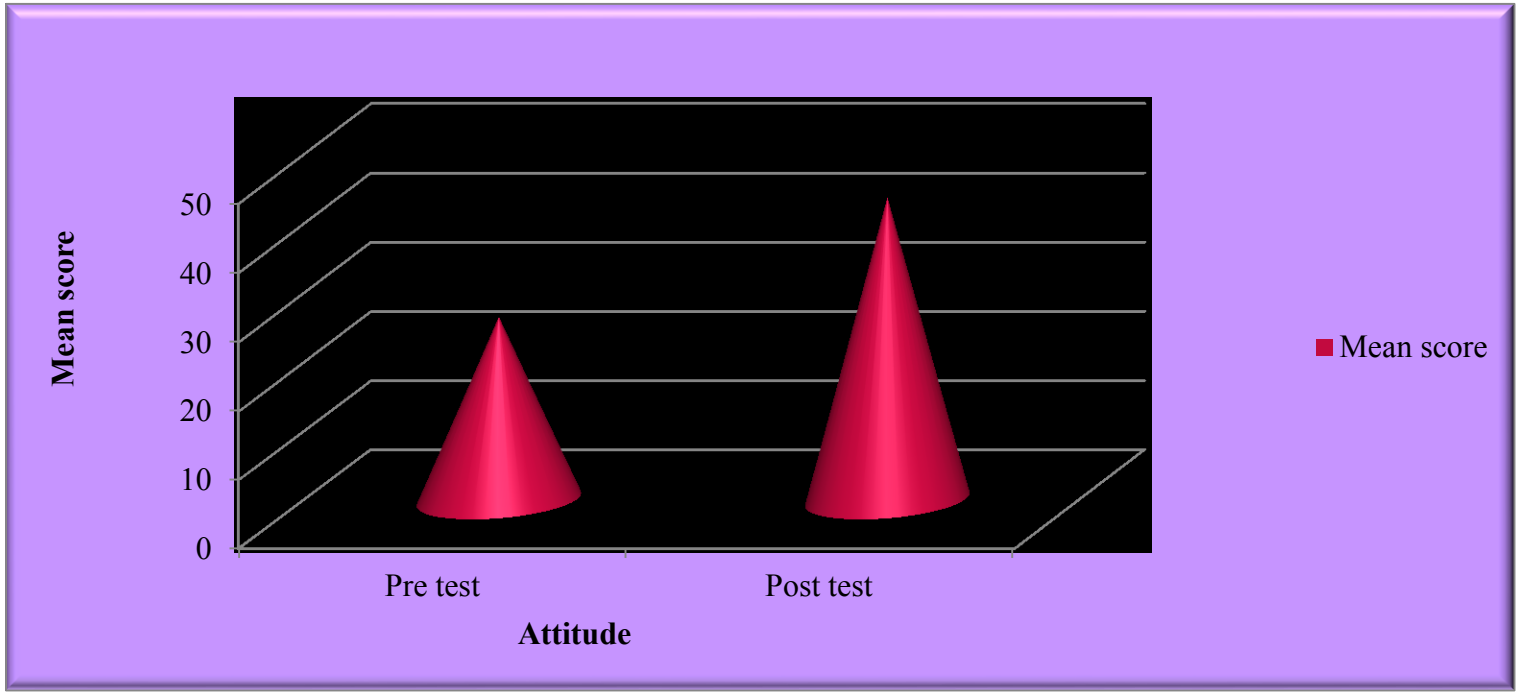


Fig: 4. Change in attitude of the respondents

The findings of the study are supported by the observations of Roy *et al.* (2013). According to him value addition training for participants of Farmers Training Institute brought a considerable positive impact in terms of the magnitude of perceived knowledge, acquisition of skills and adoption level of respondents. He also found out that attitude towards value addition was significantly related to adoption level of value addition practices at 0.5 per cent of probability.

Based on the findings of the present study it may be concluded that changes in attitudes and levels of knowledge obtained from acceptance of new ideas from effective training programmes will ultimately lead to practice what is being learnt. Cicil (2000) reported that the impact of educational programme on mushroom consumption had significant positive role at all levels in terms of nutritional knowledge gained and change in attitude. Data collected after a training programme by Suresh (2001) also revealed that majority of respondents had shifted to highly favourable attitude towards food safety measures.

5.9.3. Adoption and Marketing of Value Added Mushroom Products

Adoption level of preparation of value added mushroom products by the respondents were collected after two months of training programme.

In this study, it was found that almost all the respondents started making value added mushroom products from their produced fresh mushrooms. Majority of the respondents made mushroom pickle (eighty eight per cent) and seventy two per cent of the respondents made mushroom chutney powder. Forty per cent of respondents prepared mushroom soup powder and forty per cent prepared mushroom wafers. About sixty per cent of the respondents preferred making dehydrated mushrooms. In contrast twelve per cent of the respondents did not prepare any value added products from mushrooms.

In this study, all of the respondents were having good level of education and they also improved their attitude and knowledge towards value addition after the

training programme. The production cost obtained for the preparation of mushroom products is also low. These may be the factors which encouraged the respondents for making value added products. Education, family income, post harvest knowledge, attitude towards value addition and knowledge on value added products were highly related to adoption level of value added practices (Roy *et al.,* 2013).

In the present study, it was revealed that the respondents who were making value added products from mushrooms were also selling their products. It is reported that about seventy two per cent of respondents were selling mushroom pickle and sixty per cent of them were selling mushroom chutney powder. Fifty six per cent of the respondents were marketing dehydrated mushrooms; twenty eight per cent respondents were selling mushroom soup powder. Mushroom wafers were marketed by twenty eight per cent of the respondents. Twelve per cent of respondents were not selling any of the products.

The value added products of mushroom have good price in international markets as well as domestic markets (Lucier *et al.,* 2003). Marketing plays an important role in the economic development of mushroom growers. In the present study, it was found that most of the respondents (ie; sixty four per cent) were marketing their products in the household level and forty four percent of them were selling through retail shops. None of them were selling their products in supermarkets.

The infrastructure available for the mushroom growers is not sufficient for some efficient arrangements for an organised sale of value added mushroom products. In a study conducted by Mishra (2010) reported that about 56 per cent of the respondents suggested small scale entrepreneurship to be set up for the value added products of mushroom and 50 per cent who suggested marketing aspect of mushroom to be covered thoroughly.

Market research is needed to identify the need of the customers as market research helps in planning the future requirements of the enterprise coping with the fast changing environment (Dwar, 1986).

5.9.4. Income Generation after Production of Value Added Mushroom Products

Value addition of agricultural commodities through minimal and ultimate processing primarily reduces wastage, ensure additional income to the farmers and also secure their income against a slump in price for fresh produce during a market glut. Most of the respondents (eighty eight per cent) reported that they got satisfactory income after making mushroom value added products. Mushroom value addition can be done in the small place of a farmer's own house for small scale production and whereby they can afford to invest in a small scale capital which generates income that aids in the family support. The income generated by the respondents was assessed by assessing the profit percentage obtained for each of the mushroom products.

According to Alom and Bari (2010), basically profitability shows the ability of a business firm to earn profit over a period of time because a business firm always earns profit to survive and grow over a long period of time. The overall measure of success of a business firm is the profitability which results from the effective use of its resources and shows the return on sales and capital employed.

In the present study, it is found that all the five mushroom products are having good profit percentage. Among the products, mushroom chutney powder and mushroom pickle are having more than fifty per cent of profit (ie; 55 and 53 per cent). Mushroom wafers is having a profit percentage of 37 per cent. Twenty five per cent of profit is obtained from dehydrated mushrooms and fifteen per cent of profit from mushroom soup powder. Through mushroom value addition, it is possible to generate considerable employment opportunity, alleviate poverty and reduce malnutrition. With low production cost and high market price, mushroom

value added products can generate higher profit potentiality of mushroom cultivators.

Prabhu, (2008) reported a similar case study in Hindu news paper and he says, a small farmer named Mr. George Thomas is doing mushroom cultivation and in addition he has also started value addition by converting a portion of the fresh mushrooms into pickles. The pickles are exported to U.S and Gulf at Rs.50 per 300gm bottle. He also giving training in order to assist all the mushroom farmers in the district to form a group as it would help them expand the market especially for value added products.

Bismi milky mushrooms growers association (BMMGA) situated in Tindivanam, Tamilnadu developed entrepreneurship among unemployed rural youth and farmers by giving training related to mushroom production, processing and value addition. A group of mushroom growers in this association started a private enterprise for mushroom value addition. Today they have at least thirty three different preparations ranging from ready to serve preparations to biscuits and powder forms of mushroom. It also served them with a monthly profit of Rs. 35,000 on an average on individual basis (Sathiah, 2008).

A survey conducted in japan among the mushroom growers revealed that the marketing of value added products like dehydrated mushrooms, soup powder and mushroom powder had made a significant improvement in their income (Ho and Peng, 2006).

In a case study, Mrs. Fathumuthu and Seenyammal, as they are mushroom cultivars, they are making 15 value added products using mushroom products. They market the product in the brand name of SMR Products. The products are mushroom pickle, mushroom chutney, jam, papad, rasam mix, kuruma mix, idli podi, bajjibonda mix, biryani mix, garammasala, rava dosai mix, uppma mix, soup mix, health mix, adai mix. The initial investment was Rs 5000. On demand each product is prepared everyday up to 5 to 10 kg. Everyday mushroom soup is sold around 200 cups and they were getting a good profit from these products.

All the above studies emphasized the significance of mushroom value addition in the empowerment of mushroom growers. Mushroom enterprise can be successful only if value added items of mushroom can be given due importance. Hence development of farmers entrepreneurship through mushroom value addition is the need of the hour and it also helps to utilise their leisure time and become self sufficient by making them empowered socially, economically and nutritionally.

In the present study, prior to the training programme more than 50% of the respondents reported that there was wastage of about 1-2kg of fresh mushrooms/ harvest. After the training programme, wastage of their produce was not reported by the respondents as all of them were doing value addition.

Hence it could be concluded that the present study has been successful in empowering the mushroom growers by increasing their knowledge and attitude towards value addition, to diminish the post-harvest losses and to generate better income by processing mushroom into value added products.

Summary

6. SUMMARY

The present study entitled “Empowerment of mushroom growers through technology transfer of value added products” was conducted among twenty five prospective mushroom growers with the objective of development of value added products from mushroom and to evaluate their shelf life quality. The study also attempted to empower mushroom growers through a training programme on value addition of mushroom and to assess the impact of the training programme conducted. The experiment was carried out in the Department of Home Science, College of Agriculture, Vellayani, Thiruvananthapuram. Major findings of the study are summarized below.

In this experiment, the first step was the development ofvalue added products from mushroom and the products developed were mushroom chutney powder, mushroom soup powder, mushroom pickle, mushroom wafers and dehydrated mushroom slices. Products prepared were assessed for their organoleptic characteristics on the basis of various quality attributes.

Study on the acceptability of the developed products showed that all the products had high organoleptic quality in appearance, colour, flavor, texture and taste perspective. The consumer preference of the value added mushroom products were also evaluated using hedonic scale by 30 respondents. It was found that all the products were liked extremely by majority of the respondents.

When the product yield ratio of mushroom products developed in the present study was calculated, it was found that the highest yield was obtained for mushroom pickle and mushroom chutney powder followed by mushroom wafers, dehydrated mushrooms and mushroom soup powder. A comparison of the cost of the mushroom products in the present investigation pointed out that mushroom chutney powder, mushroom soup powder and mushroom wafers were cheapest. The cost of all the

mushroom products was found to be lower than the similar products seen in the market.

The shelf life qualities of value added mushroom products were assessed initially and periodically for four months and the qualities analyzed were organoleptic quality, acidity, pH, moisture, peroxide value and microbial changes.

The periodical evaluation on organoleptic qualities of mushroom chutney powder revealed that there was only a slight change noted in all the quality parameters during the entire storage period. In the case of mushroom soup powder, colour, flavor and taste remained constant and the other parameters showed only a negligible variation. Mushroom pickle, mushroom wafers and dehydrated mushroom slices also showed only a slight decrease which was not significant. It can be concluded that no quality deterioration occurred to influence the products acceptability and reasonably good acceptability was observed even after eight months of storage.

Examination on chemical changes of mushroom chutney powder showed that the initial values of acidity was 0.46 per cent, moisture of 2.74 per cent, pH of 5.2 and peroxide value of 0.166 meq/100gm. There was only a slight variation observed in all the chemical parameters and no significant change was noticed.

In mushroom soup powder, the initial values of acidity was 0.34 per cent, moisture of 0.52per cent, pH of 4.78 and peroxide value of 0.024meq/100gm. Only a negligible change was observed during the entire storage period and it was not significant. The initial values of acidity of mushroom pickle was 0.76 per cent, moisture of 44.48 per cent, pH of 3.96 and peroxide value of 0.044 meq/100gm. Here also no significant difference was noted as there was not much variation. Mushroom wafers is having an acidity value of 0.63 per cent, moisture of 1.2 per cent, pH of 4.9 and peroxide value of 0.012 meq/100gm. There was only a minimal increase in acidity, moisture and peroxide and no significant difference was noted. In

dehydrated mushroom slices the initial value of acidity was seemed to be 0.32 per cent, moisture of 2.43 per cent, pH of 4.63 and peroxide value is not seen until the end of second month. By the end of fourth month, a negligible value of peroxide was seen and that is 0.013meq/100gm. All of the chemical parameters have showed a slight change during four months of storage but it was not significant. On examining the above results, it was evident that all the products showed ability at ambient conditions for storage of four months.

Results of microbiological examination revealed that there was complete absence of microorganisms in the product like mushroom soup powder, mushroom pickle and dehydrated mushrooms. The products such as mushroom chutney powder and mushroom wafers showed one or two yeast colonies at the end of fourth month which was under the permissible limits.

For the conduct of the technology transfer, twenty five mushroom growers were purposively selected from the list of mushroom growers who were earlier trained at College of Agriculture, Vellayani, forming the study sample.Results of personal and socio economic survey showed that majority of the respondents belonged to the age group 30 – 40 years and most of the respondents (80 per cent) were female. Religion wise distribution of respondents revealed that 62 per cent of respondents were Hindu community and 40 per cent from Christian community. While analyzing the family type majority of the respondents (92 per cent) belonged to the nuclear family.

Regarding educational status of the respondents, it was found that all of the respondents were educated and majority of the respondents (40 per cent) have acquired BSc/ BA degree.36 per cent of the respondents had studied up to High school, 20 per cent had studied up to pre degree and four per cent of the respondents had acquired post-graduation. Concerning the occupation, most of the respondents (56 per cent) were seen to be housewives. Family income of the respondents

indicated that 48 per cent of the respondents were having income of 10,000-15,000 per month.

Study on mushroom cultivation, production and training revealed that majority of the respondents (56 per cent) were cultivating mushroom for more than two years. Almost all the respondents (96 per cent) had started mushroom cultivation after attending a training programme on mushroom cultivation and 68 per cent of the respondents had attended training classes for mushroom cultivation for a period of 2-3 days. Regarding the area of mushroom cultivation, about 40 per cent of respondents were cultivating mushrooms in nearby home shelters and about 36 per cent of the respondents were doing mushroom cultivation in house itself and 24 per cent of the respondents were using particular buildings. It was also revealed that majority of the respondents (92 per cent) were producing mushroom about 1 - 10kg from each harvest. 76 per cent of the respondents were harvesting 10 - 20 times in a year and sixteen per cent of them were harvesting more than thirty times in a year. Details on type of mushroom cultivated by the respondents shown that 60 percent of the respondents cultivated both oyster and milky mushrooms.28 per cent of them were producing only oyster mushrooms and 12 per cent of the respondents were producing milky mushrooms. Details of sales of fresh mushroom by the respondents indicated that all of the respondentswere selling their mushrooms for 200 - 300Rs/kg and they were on the opinion that mushroom cultivation is profitable. It was also observed that 40 per cent of the respondents had an income of above Rs.4000 from mushroom cultivation.

Distribution of respondents based on marketing of fresh mushroom revealed that 56 per cent of the respondents were marketing their produce at nearby houses, 32 per cent through shops and 12 per cent through offices. It is also found that 76 per cent of the respondents were using direct method for selling their produced mushrooms and 16 per cent were selling through agents and8 per cent through shops.

Study on spoilage of mushrooms indicated that the majority of respondents (96 per cent) were not able to sell the mushroom completely on the harvested day and 92 per cent of the respondents experienced spoilage in mushrooms during storage. It was found that majority of respondents (56 per cent) experiencedspoilage of 1000-2000gm of mushroom/ harvest, 28per cent experienced a lossof 2000-3000gm and 8 per cent experienced spoilage of more than 3000gm. It was seen that most of the respondents were not having knowledge about value added products from mushroom. Lacuna in the knowledge of the respondents with regard to appropriate processing methods may be the reason for the spoilage of fresh mushrooms and lesser income.

Based on the results obtained, a training programme on technology transfer of value added products of three days duration was conducted for the mushroom growers selected for the study. Prior to the conduct of training programme, the existing knowledge and attitude of the respondents were assessed, so as to find out the impact of the intervention programme.

Results of the pre test on knowledge of the respondents conducted before the training programme revealed that the mean knowledge score of the respondents was only 4.12 out of a maximum of 10 and the study on attitude of the respondents prior to the training programme revealed that the mean attitude score of the respondents was 26.4 out of a maximum of 50. Both knowledge and attitude of the respondents towards value addition was found to be poor. The influence of the training programme on knowledge and attitude was assessed immediately after the programme and it showed that there was significant change in knowledge and attitude among the respondents showing the positive outcome of the programme.

The impact of training programme in terms of adoption of mushroom processing, sale of products and income generated was assessed after a lapse of two months. The results showed that after the training, majority (88 per cent) of the respondents adopted mushroom processing and value addition. It was also found that

most of the respondents produced mushroom pickle (88 per cent) and mushroom chutney powder (72 per cent). Details about marketing of mushroom products revealed that most of the respondents were producing mushroom pickle and mushroom chutney powder since the profit percentage was found to be high for these items. The profit percentage of mushroom chutney powder was found to be 55 per cent and mushroom pickle was 53 per cent.

Regarding the area of marketing of value added products, it can be found that most of the respondents (64 per cent) were marketing their products innearby households and 44 percent were selling through retail shops. None of them were selling their products in supermarkets. As the time period for impact evaluation was very limited, all of the respondents were started to make the value added products. There was not enough time for the respondents to fetch their products in generalized markets.

Even then eighty eight percent of the respondents reported that they were getting satisfactory income by making value added products. Hence an extended time period will result in boundless production and marketing of value added mushroom products thereby creating a high market linkage which will help in income generation and empowerment of mushroom growers.

The study has been successful in empowering mushroom growers through technology transfer of value added products of mushroom by making them aware of various processing methods and different mushroom products, enhancing their attitude towards value addition of mushroom and ensuring a steady income through sale of mushroom products at the same time avoiding wastage of their produce.

Based on the study following recommendations are put forward,

- Up gradation of mushroom value addition as an income generating activity by the kudumbasree/SHG units or others engaged in

mushroom production. Establishment of a sound marketing linkage with organisations like Kudumbasree will help to enhance production and marketing of mushroom products.

- Further research and development in the field of mushroom value addition should be taken up.
- Training programme on value addition of mushroom must be conducted along with mushroom cultivation.

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Appaendices

APPENDIX - I

Score card for organoleptic qualities of mushroom products

Particulars	Criteria	Score	Product
Appearance	Excellent	5	
	Good	4	
	Fair	3	
	Poor	2	
	Very poor	1	
Colour	Highly acceptable	5	
	Moderately acceptable	4	
	Fairly acceptable	3	
	Less acceptable	2	
	Not acceptable	1	
Flavour	Excellent	5	
	Good	4	
	Fair	3	
	Poor	2	
	Very poor	1	
Texture	Excellent	5	
	Good	4	
	Fair	3	
	Poor	2	
	Very poor	1	
Taste	Excellent	5	
	Good	4	
	Fair	3	
	Poor	2	
	Very poor	1	

Name: **Date:**

APPENDIX - II

Hedonic rating scale for the preference of mushroom products

Rating	Score	
Like extremely	5	
Like very much	4	
Like moderately	3	
Like slightly	2	
Neither like or dislike	1	

Name:

Date:

APPENDIX – III

Composition of media for microbial analysis

Nutrient Agar

Peptone - 5g
Nacl - 5g
Beef extract - 3g
Agar - 20g
Distilled water - 1000ml

EMB Medium

EMB - 36g
Distilled water - 1000ml

Kenknights Agar

Dextrose - 1g
KH2PO4 - 0.1g
NANO3 - 0.1g
KCL - 0.1g
MGSO4.7H2O - 0.1g
Agar - 15g
Distilled water - 1000ml

Rose Bengal Agar

Glucose - 10g
Peptone - 5g
KH2PO4 - 1g
MGSO4.7H2O - 0.5g
Streptomycine - 30mg
AGAR - 15g
Rose Bengal - 35mg
Distilled water - 1000ml

APPENDIX - IV

Interview schedule to elicit information on personal and socio economic characteristics of the respondents

1. Name of the respondents :
2. Age :
3. Sex :
4. Address :
5. Religion :
6. Type of family : Nuclear/ Joint
7. Educational qualification :
8. Occupation :
9. Family income/ month :
10. Details about the family

Sl. no	Name of members	Relation to respondents	Sex (M/F)	Educational qualification	Job	Income

APPENDIX - V

Schedule to collect the details about the mushroom cultivation and processing

1. How long have you been cultivating mushroom?

   ☐ 1 year ☐ 2 years ☐ More than 3 years

2. Did you attend any training programme on mushroom cultivation?

   ☐ Yes ☐ No

3. If yes, what is the period of training programme?

   ☐ 1 day ☐ 2 days ☐ > 3 days

4. Where is the location for your mushroom cultivation?

   ☐ Particular buildings

   ☐ In the home

   ☐ Nearby home

   ☐ Others

5. What is the yield of mushroom in one harvest?

   ☐ 1-10 kg

   ☐ 20-30 kg

   ☐ 40-50kg

6. How many times do you harvest/ year?

   ☐ 10-20 times

   ☐ 20-30 times

   ☐ Above 30 times

7. What are the types of mushroom you are cultivating?

   ☐ Oyster mushroom

   ☐ Milky mushroom

   ☐ Both oyster and milky mushrooms

8. What is your selling price per kg of mushroom?

9. Are you getting profit from mushroom cultivation?

   ☐ Yes ☐ No

10. How much is the income obtained per month from the mushroom cultivation?

11. Where do you sell the fresh mushrooms?

   ☐ Shops

   ☐ Melas

   ☐ Krishibhavan

   ☐ Through kudumbasree

   ☐ Door to door sales

12. What are the type of methods used for selling?

- ☐ Directly
- ☐ Through agents
- ☐ Nearby shops
- ☐ Government agencies

13. Do you sell the mushrooms on the same day of harvest?

☐ Yes ☐ No

14. Do you face any problem of spoilage of mushroom after harvesting?

☐ Yes ☐ No

15. Amount of mushroom spoilt per harvest?

- ☐ 1000 - 2000gm
- ☐ 2000 - 3000gm
- ☐ Above 3000gm

16. Do you have any knowledge about value added mushroom products?

☐ Yes ☐ No

17. If yes, name the value added products that you make?

18. Did you start mushroom value addition after attending the training programme?

☐ Yes ☐ No

19. If yes, name the products you made?

20. Did you market these products?

☐ Yes ☐ No

21. If yes, what is the mode of your marketing?

☐ Household

☐ Retail shop

☐ Super market

☐ Any other

22. Details of production and sale of mushroom products?

Products	Cost of production	Selling price	Profit obtained

23. In your opinion, is mushroom value addition profitable?

☐ Yes ☐ No

APPENDIX - VI

Interview schedule to elicit information on knowledge of the respondents towards value addition in mushrooms.

Sl no:	Statements	Yes	No
1	After the harvest, mushrooms get spoiled within a short duration because of its white colour.		
2	Mushroom value addition will result in the availability of mushroom throughout the year.		
3	Changes in the quality of value added mushroom products will also depend upon their packaging.		
4	Pre treatment with sodium, potassium meta bisulphate and citric acid will help to retain the colour of fresh mushroom.		
5	Sun drying and oven drying have the same impact on maintaining the quality and colour in mushrooms.		
6	Usage of cold storage mushrooms immediately after taken from this temperature is not necessary.		
7	Value added mushroom products have very low nutrients in it.		
8	Button mushroom is more suitable for making value added products rather than oyster and milky mushrooms.		
9	Value added products of mushroom can increase the shelf life of fresh mushrooms.		
10	Value added products reduce the consumption of fresh mushrooms.		

NAME: DATE:

APPENDIX - VII

Interview schedule to elicit information on attitude of the respondents towards value addition in mushrooms.

Sl no:	Statements	SA	A	UD	D	SD
1	Mushroom is a delicacy liked by all					
2	Mushroom cultivation is more profitable.					
3	A variety of nutritious products could be made using mushrooms.					
4	Mushroom processing and value addition increase the family income.					
5	Mushroom should not be included in the diet during rainy season.					
6	Mushroom processing is profitable.					
7	Consumption of value added mushroom products is injurious to health.					
8	Value added Mushroom products get spoiled easily.					
9	Preparation of value added mushroom products is an easy task.					
10	Mushroom products should be given to the children only in limited amounts.					

NAME: DATE:

APPENDIX – VIII

Teaching aid used in training programme (BOOKLET)

Abstract

ABSTRACT

The study entitled "Empowerment of mushroom growers through technology transfer of value added products" was conducted at the Department of Home Science, College of Agriculture, Vellayani, during 2012-14. The study was aimed at the standardization of processed mushroom products and to empower mushroom growers through technology transfer. Impact of the technology transfer on the profitable utilization of mushroom was also assessed.

Commercially cultivated varieties of mushroom such as Oyster mushrooms (*Pleurotus florida*) and Milky mushrooms (*Calocybe indica*) were purposively selected and collected from the Instructional farm, College of Agriculture, Vellayani and also from the local mushroom growers in Thiruvananthapuram for the purpose of study.

Five processed products namely, dehydrated mushroom, mushroom soup powder, mushroom chutney powder, mushroom pickle and mushroom wafers were selected and standardised and their acceptability and shelf life for a period of four months were also ascertained.

During the period of four months of observation it was found that there were no significant changes in moisture, peroxide, pH, acidity and microbial count. The cost of production of various products was also affordable indicating better economic viability.

The technology transfer of these standardized products was conducted among twenty five mushroom growers selected from those who were trained at College of Agriculture, Vellayani. Data regarding the socio-economic status, knowledge and attitude of respondents towards value addition of mushrooms were also obtained using interview schedule. The respondents were provided training on mushroom value addition for three days in the Department of Home science, College of Agriculture, Vellayani. The impact of training programme was evaluated after a lapse of two months.

All the respondents were of the opinion that mushroom cultivation is profitable and forty percent of the respondents obtained an income of rupees four thousand per month from mushroom cultivation. Majority of the respondents (56%) were facing the problem of spoilage of about 1000-2000g of mushroom per harvest. Study of the knowledge gain of the trainees and their attitude after two months of training programme revealed that their knowledge improved significantly and their attitude towards processing mushroom too showed significant change. After the training programme, majority of the respondents (88%) started making mushroom pickle followed by 72% making chutney powder and 60% dehydrated mushrooms for sale. Seventy two percent of trainees were started selling mushroom chutney powder. As the time gap was limited between the intervention and the impact evaluation it was seen that majority of the trainees repressed into household level of processing and marketing with satisfactory profit.

Hence it could be concluded that the study has been successful in empowering mushroom growers through technology transfer of value added products of mushroom by making them aware of various processing methods and different mushroom products. The study was also useful for enhancing their attitude towards value addition of mushroom and ensuring a steady income through sale of mushroom products by avoiding wastage of their produce.

Establishment of a sound marketing linkage with organisation like kudumbasree will help to enhance production and marketing of mushroom products by growers.