

## **ICAR-IIHR Mushroom Licensed Technologies**

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# 1. Arka Mushroom

## Machinery (MUSHROOM SPAWN PRODUCTION MACHINERY)

The consumption of mushroom is becoming very popular in fast foods in India. A large number of mushroom production units are coming up. These mushroom production units need spawn regularly for production of mushroom. The machineries for mushroom spawn production have been developed.

Grain cleaner is for cleaning the grains by oscillating sieves. A grain boiler is operated by 9-12 kW electric power. The integrated grain mixer cum grain filler is for mixing boiled grains with chalk powder and filling spawn to pp bags. Spawn inoculator used inoculating mother, Generation-1, Generation-2 and commercial spawn has also been developed. These machineries have been developed for 170 kg per day of spawn production.

The use of machineries will reduce the labour requirement by 50%, power requirement by 60 % and labour efficiency is increased. The contamination of spawn is also reduced.



**ICAR-IIHR designed  
Grain Cleaner:**  
**Use to clean the grain  
from dust, sticks etc.**  
**Capacity: 200 kg/h**



**ICAR-IIHR designed  
Grain Boiler:**  
Boils grains in hot water  
with 9 kW electric  
heaters  
**Capacity: 100 kg/batch**



**ICAR-IIHR designed  
Integrated rain Mixer  
cum Grain cleaner:**  
Mixes boiled grain with  
chalk powder and fills  
the mixed product into  
PP bags  
**Capacity: 100kg/batch**





**ICAR-IIHR designed  
Solar energy integrated  
vertical autoclave with  
separate boiler:**

**Uses solar hot water,  
steam & electrical energy  
in sperate boiler, sterilize  
spawn/paddy straw filled  
PP bags**

**Capacity: 140kg/batch  
(Spawn)  
35 bags (Paddy straw,  
1kg)**



**ICAR-IIHR designed  
Spawn inoculator:**

**Used to inoculate mother  
spawn to G1, G1 to G2 &  
G2 spawn to cultivation  
spawn.**

**Capacity: 100 bags/h**

## **2.Arka Mushroom Rasham : Mushroom Fortified Instant Rasam Mix**

Mushroom Fortified Instant Rasam Mix Mushrooms, a rich source of proteins superior to most common fruits and vegetables with the exception of beans and peas provide 29% of the recommended daily intake (RDI) for vitamin B2 (riboflavin) and 23% of the RDI for niacin and are the only natural vegetarian source of vitamin D. Mushrooms are a better source of iron as compared to vegetables and thus can be an effective tool to mitigate iron malnutrition in the country. Due to their low glycemic index and zero cholesterol, they are specially recommended for diabetics and cardiac health. They are also the source of various bioactive substances which have antibacterial, antifungal, antiviral, antioxidant, anti-inflammatory, antiproliferative, anticancer, hypocholesterolemic, anticoagulant and hepatoprotective, properties. The Mushroom Research laboratory at ICAR-IIHR, Bengaluru, India, has developed a robust technology called Mushroom Fortified Instant Rasam mix, a value added product for enhancing the nutrition in the daily diet of the urban and rural population. This product has been standardized with an objective to add nutrition to a daily diet product 'Rasam' used daily in every South Indian home. Daily intake of this product will not only help in enhancing nutrition but can also enhance income of rural women who can start an entrepreneurial activity of producing this product as cottage industry. Since the mushroom fortified instant rasam mix is made from dehydrated oyster mushrooms; it can also be an important technology to solve the short shelf life of oyster mushrooms and enhance oyster mushroom production in India.



**Mushroom Fortified Instant Rasam Mix**

### **3. Arka Mushroom chutney powder: Mushroom value added products- A blend of tradition, nutrition and taste**

The Arka Mushroom chutney powder technology relates to the usage of dry oyster mushroom for the production of mushroom chutney powder or chutney podi which can be used for the nutrition enhancement of daily household diet both at rural and urban levels. Although mushrooms are very well known for their culinary medicinal properties, their consumption has been limited due to short shelf life, irregular availability and high cost. People are not aware about the usage of dry mushrooms and the ways in which mushrooms can be fortified in everyday diet to enhance its flavor and nutrition. The seven variants of Arka mushroom chutney powder combines the traditional taste and nutritive goodness of mushrooms with traditional healing herbs like Brahmi, Moringa leaves and traditional nutritive seeds like flax seeds, sesame seeds, ground nut and coconut. It is a novel product to be consumed daily as a daily food accompaniment with any traditional Indian food. It is a ready to eat powder and can be easily adopted in mid day meals and defense food. It has a shelf life of 3 months in airtight containers/pouches at ambient temperature (26-28°C) which can be extended at lower temperature. It can be taken up as entrepreneurship by women SHGs, war widows, disabled soldiers and other rehabilitation programs. Hence this technology will be of immense importance to enhance nutrition if adopted under nutrition programs and also help in income enhancement of rural women, war widows, disabled people.

## Nutrition analysis of Arka Mushroom fortified chutney powders

rients	Mushroom Coconut Chutney powder	Mushroom Groundnut chutney powder	Mushroom White Sesame chutney powder	Mushroom Black sesame chutney powderwith mushroom	Mushroom Flax seed chutney powder	Mushroom Moringa leaf chutney powder	Mushroom Brahmi chutney powder
Protein (%)	16.62	27.56	28	25.59	19.25	1.31	11.31
Carbohydrates(%)	35.61	17.536	18.31	23.11	19.99	28	0.007
Fat (%)	10.54	14.92	18.55	17.23	13.67	6.71	1.47
Fiber (%)	9.60	14.37	11.13	13.58	15.87	11.38	0.377
Phosphorous (%)	0.365	0.44	0.565	0.605	0.45	0.007	0.133
Pottassium (%)	1.54	1.15	1.14	1.585	1.495	1.11	243
Calcium (%)	0.230	0.380	0.325	0.125	0.13	0.336	20.80
Magnessium (%)	0.09	0.10	0.14	0.115	0.145	0.170	9.95
Iron (PPM)	76.5	104	129	131.5	110.5	99.53	82.50
Manganese (PPM)	37.5	16	16	17	17	15.23	-
Copper (PPM)	8	4.5	7.5	10	6	8.96	-
Zinc(PPM)	12	52	66.5	62	51.5	39.16	-



**i. Mushroom white sesame chutney powder**



**ii. Mushroom Black sesame chutney powder**





**iii. Mushroom Moringa leaf chutney powder**



**iv. Mushroom Coconut chutney powder**



**v. Mushroom Groundnut chutney powder**



**vi. Mushroom Flax seed chutney powder**



**vii. Mushroom Flax seed chutney powder**

## **4. Arka mushroom millet cookies**

The Arka mushroom millet cookies technology relates to the usage of dry Elm oyster mushroom (*Hypsizygus ulmarius*) powder in combination with 5 different millet flours (sorghum or jowar or sorghum vulgare, pearl millet or bajra or Pennisetum glaucum, corn or maize or Zea mays, finger millet or ragi or Eleusine coracana and little millet or sawai or Panicum sumatrense) for the production of mushroom millet cookies. Both mushrooms and millets are well known for their culinary medicinal properties. Mushrooms are novel horticultural crop gaining importance. Mushrooms are a very good source of protein, fibre, iron, vitamin B & D, potassium, phosphorus, Selenium and copper. They also contain polysaccharides and antioxidant ergothioneine which are immune stimulators and anti-cancer agents. Mushrooms are extremely good for diabetics and heart patients due to their low energy, very low fat, no sugar, ability to reduce cholesterol and triglycerides. Millets are once again regaining their importance as a staple source of food due to their varied nutritional potential. Blended or combination food or food products can be an important way to diversify the food plate and obtain balanced nutrition as well. Development of mushroom millet cookies is a step towards blending the nutritional goodness of mushrooms and millets for better taste and nutrition. This technology can also help in the development of entrepreneurship through the production of these products.



**Arka Mushroom sorghum cookies**



**Arka Mushroom Bajra cookies**



**Arka Mushroom maize cookies**



**Arka Mushroom little millet cookies**



**Arka Mushroom Finger millet cookies**

## 5. Arka Iron fortified mushroom

- It is production of iron fortified elm oyster mushroom (*Hypsizygus ulmarius*)
- The iron content of iron fortified mushroom has increased from 135.60ppm in non-fortified mushroom to 338.15ppm in iron fortified mushroom which is an increase of 149.37%.
- The bioavailability of iron from iron fortified mushroom is 21.68% which is very high as compared to iron bioavailability from plant sources which is 5-8% or from inorganic iron supplements which is 10-12%.



**Dehydrated iron fortified mushroom**



**Rehydrated iron fortified mushroom**

## 6. Arka Vitamin D enrichment in Elm oyster mushroom

Vitamin D plays a vital role in maintaining overall physiological and biochemical well-being by supporting bone health through calcium absorption and regulating the immune system. Surprisingly, despite India's abundance of sunshine, a significant percentage (50-94) of its population suffers from a deficiency of this essential vitamin. Mushrooms offer a valuable source of ergosterol, a precursor that can be efficiently converted to vitamin D<sub>2</sub> (ergocalciferol) when exposed to sunlight or UVB radiation. To produce nutrient-labelled vitamin D rich mushrooms on a commercial scale, it is crucial to establish a standardized technique that ensures consistent production of these enriched mushrooms. Additionally, the amount of ergosterol present in mushrooms is specific to each species, requiring the development of species-specific protocols to facilitate commercialization. Thus, current research was focused on standardization of protocol for enriching vitamin D-rich Elm oyster mushrooms (*Hypsizygus ulmarius*). An indigenous, low cost UVB exposure device was designed and fabricated specifically for vitamin D enrichment for mushrooms under laboratory conditions. The Vitamin D-enriched oyster mushrooms can be consumed either in their fresh form or dehydrated and powdered for long-term storage as a natural daily Vitamin D supplement. The powdered Vitamin D-enriched mushroom can be encapsulated, added to daily dietary products such as mushroom rasam or ragi balls, or simply consumed as soup by mixing it with boiling water. The research work carried out at the Institute resulted in the development of a cost-effective technology to produce vitamin D-enriched mushrooms in *Hypsizygus ulmarius* (elm oyster) variety. Additionally, stability of vitamin D in the enriched mushrooms revealed that it could be maintained up to six months.



**Exposing the mushroom to UV B light**



**Vitamin D enriched elm oyster mushroom**

## 7. Arka Mushroom Growing Unit



**Fig. Solar Power Integrated Outdoor Mushroom Growing Unit**

The present technology relates to the production of oyster mushroom by using low cost Solar Power Integrated Outdoor Mushroom Growing Unit which can be at both rural and urban levels. Presently most of the growers are using permanent or semi permanent structures for growing these mushrooms. The newly designed outside mobile chamber is low cost in comparison to the permanent building and even during non favourable conditions like months of April and May, the mobile chamber gives a better environment for mushroom growing due to its evaporative cooling principal as compared to permanent structures. As the availability of the space and capacity of the investment is less, maintenance is easy and less costly for adoption. Such structures will help in developing entrepreneurship not only in mushroom cultivation but also to fabricate and sell the units to the needy growers. It enhances mushroom cultivation to make mushroom as a part of diet. Daily consumption which can help in mitigation of malnutrition and also additional income can be generated for entrepreneurship development especially among women.



The overall dimension of the growing chamber is 1.35 x 0.93 x 1.69 m which is made up of 1" CPVC pipes and fittings. It is covered with nylon 40 mesh to protect the entry of insects and to facilitate the aeration. It is further covered with locally available gunny bag all around and it is wetted to maintain humidity inside the chamber. A 30 W DC misting diaphragm pump with 10 nozzles of 0.1 mm size to produce more than 100 bar pressure to get very fine misting inside the chamber. It can be operated either by electric power or using Solar power system with 300 W panel, inverter, 12V storage battery and a timer. The entire growing chamber is fitted inside a mild steel frame of 1.08 x 1.48 x 1.8 (side height)x 2.2 (centre height) with mobile wheels for easy mobility and transport. The solar panels are mounted on the roof top of the frame and inverter and battery are mounted and supported in the frame. A 30 litre water tank is fitted at the bottom side of the frame along with the misting pump. It was evaluated by growing two varieties of oyster varieties viz., 20 bags (1 kg) of Elm oyster and White oyster mushroom were evaluated both at cropping room and outside chamber every month from 2016 to 2018. The average yield recorded during 2016 to 2018 shows that there is an average increase of 108 % in Elm oyster yield in mobile chamber in comparison to the cropping room yield. Similarly, an increase of 51% mushroom yield was recorded in white mushroom yield. The average monthly mushroom yield from this structure is 25-28 kg.

## 8. Arka Tricycle



**SOLAR POWER OPERATED TRICYCLE CART FOR VENDING READY TO HARVEST FRESH MUSHROOM**



Mushroom is known for its nutritional and medicinal qualities and benefits. There is a need to enhance these beneficial aspects among the rural and semi urban people. This can be achieved by selling the fresh mushrooms at consumers doorstep. This can be achieved at larger scale by growing mushroom in ICAR-IIHR outdoor mobile chambers and take the flushing growing bags in the Solar power operated tricycle cart for vending fresh mushroom to the consumer for vending. It will make mushroom as a part of daily diet which can help in mitigation of malnutrition.

It can be suitable both at rural and urban levels. Presently most of the growers are packing the mushrooms and selling through the push cart vendors or stores. The shelf life of these packages is 2-3 days. The newly designed solar powered tricycle cart holds the mushroom growing bags and the mushrooms are harvested and sold to the consumers at their doorstep. It facilitates the

consumers to select the quality of mushroom from the growing bags to their choice and take home the freshly harvested mushroom. It can also help in customization of selling the produce in terms of freshly plucked mushroom, different coloured oyster mushrooms, mushroom vegetable combos, bags at different harvesting stages of mushrooms according to consumer preference. It can be one

The overall dimension of the mushroom bags holding chamber is 1.5 x 1 x 1 m which is made up of aluminium frames and fittings. It is covered with nylon 40 mesh to protect the entry of insects and to facilitate the aeration. It is further covered with locally available gunny bag all around and it is wetted to maintain humidity inside the chamber. It can hold 36 Nos of 1 kg/2kg bags inside the chamber. A 30 W DC misting diaphragm pump used to wet the gunny bags to manage relative humidity through evaporative cooling inside the chamber. It can be operated either by electric power or using Solar power system with 300 W panel, inverter, 12V storage battery and a timer. The entire growing chamber is mounted on a tricycle frame. The tricycle is powered by a 48V , 750 W DC geared motor. A voltage controller and Lithium Ion battery of 24 Ah is used to store solar power to source DC power to geared motor and mist pump. The solar panels are mounted on the roof top of the frame.