

Post - Harvest Management of Mushrooms with Special Reference to Himachal Pradesh

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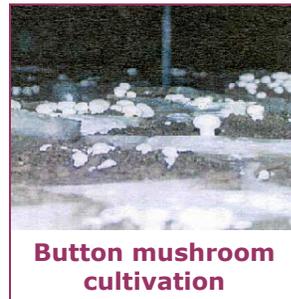
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SUMMARY

In Himachal Pradesh, the commercial production of mushroom started during late sixties on an experimental basis by Dr.E.F.K.Mantel, an Agricultural Scientist under FAO Programme. The College of Agriculture, Solan took the lead and provided initial research facilities. Sri Amarinder Singh was the pioneer grower to venture in the field. The raw materials used were wheat straw, spent brewer's grain from Solan distillery, wheat bran, super phosphate, murate of potash and urea. The spawn was provided by agriculture college, Solan, and spent mushroom compost, sand, saw dust and loamy soil formed the casings. Around early seventies some growers of Chail and Kasauli produced few hundred kgs. of mushroom per day which was canned by TEGS Mushroom.



Oyster mushroom cultivation



Button mushroom cultivation

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Himachal Pradesh emerged as a major state of mushroom cultivation where small growers, co-operative growers societies, big farmers and some corporate organisations are engaged in production. Since, it is an ideal state for development of mushroom industry, several commercial units in organised/corporate sector have come up in Himachal Pradesh. The major growing districts are Solan, Shimla, Kangra, Mandi, Kullu and Sirmaur. Due to improved quality of compost, better market facilities, small and medium sized units have been established around Shimla and Solan. However, some limiting factors such as inadequate financial facilities, high cost of transportation in hilly areas, inadequate post harvest infrastructure, rising cost of inputs are coming in way of expected progress.

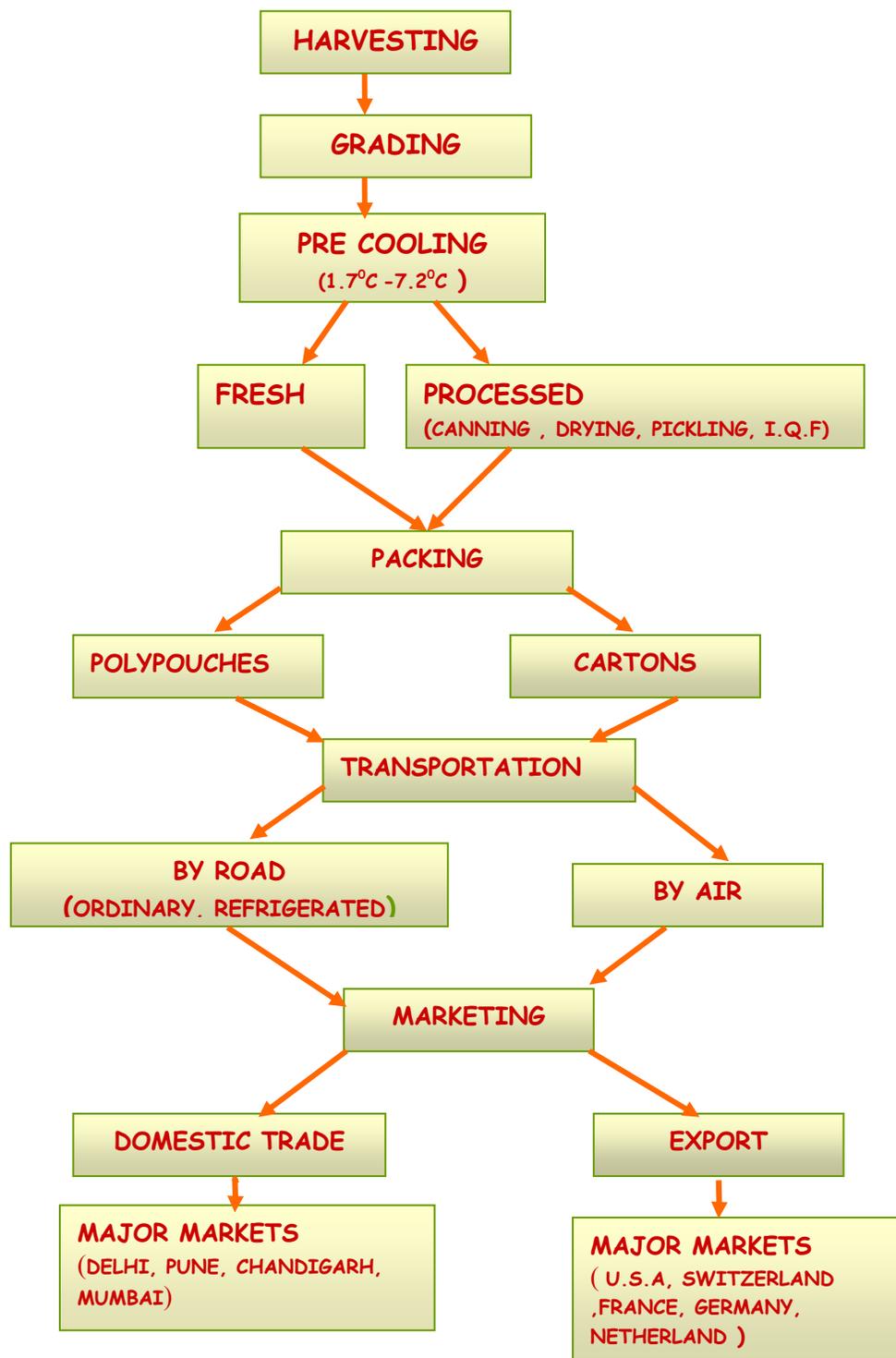
Increased productivity demands proper post harvest infrastructure to increase shelf life and marketability. Since mushrooms are perishable and delicate in nature, these cannot be kept afresh for more than 24 hrs. After the maturing of the fruiting body, the deterioration starts with the formation of brown colouration and hence the quality deterioration and loss of marketability. To overcome this problem, specially during peak season, suitable post harvest management/practices are to be followed to increase the shelf life and marketability of mushrooms. Initial steps are, proper harvesting time and stage. Mushrooms are generally harvested after 3 weeks of casing. Button mushrooms are to be harvested when the CAP size is 30-45 mm in diameter, whereas Oyster mushroom is harvested when the fruiting body becomes curled under edges and well formed gills.



Harvesting of mushroom

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POST HARVEST PRACTICES OF MUSHROOM

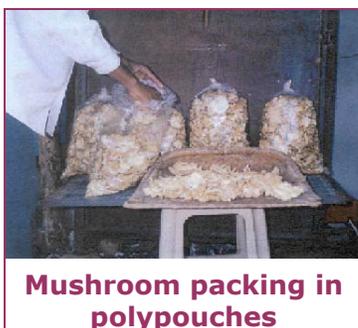


Grading of mushrooms is important for marketing. Generally, the grading is done by segregation of mushrooms into various grade standards as per market demand. For example button mushrooms are graded into Grade A, B and C. The Directorate of Marketing & Inspection (D.M.I.) had formulated the grade standards for dried edible mushrooms as Mushrooms Grading & Marking Rules, 1972 under the Agricultural Produce (Grading & Marking) Act, 1937.

Other step is pre-cooling wherein the produce is kept in a plastic bag and stored in cooling unit. Vacuum cooling is another cooling system where water existing in cell walls and inter hyphal spaces of produce is evaporated under pressure which lowers the temperature. But it is cost oriented system and involves inevitable loss of fresh weight.

Packing is essential to protect the mushroom during marketing. It is generally packed in polythene bags of 250 gm-400 gms for local markets. For long distance transport, pulp board punnets wrapped with PVC films should be used instead of polythene bags. Sometimes, pre-cooled mushrooms are packed in insulated containers having ice in it, so that Mushrooms remain fresh, healthy during long transport.

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The effect of pre cooling is lost partially in post pre-cooling period. Hence, for long distant transport, speedy refrigerated transport system is essential in which CFB cartons containing polythene pouches of mushrooms may be transported by refrigerated trucks. For short distance markets, precooled fresh mushrooms are despatched in wooden boxes with sufficient crushed ice in polypacks. For local retailer's markets mushrooms are packed in polypouches and despatched by cycle, cycle-rickshaws, auto-rickshaws etc.

Mushrooms are marketed as fresh, dried and preserved. In Himachal Pradesh, it is mainly marketed in fresh form. The major quantity of Himachal mushroom is consumed in plains of Punjab, Haryana and Delhi during Oct-Nov and Feb-May. During Dec-January, the produce of plain areas also arrives in markets. The middlemen and commission agents collect produce from growers and despatch to regulated markets/satellite markets or markets outside the state. From consumption trend, it is seen that people of high income group and restaurants catering them are main buyers of mushrooms.

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Fresh mushroom



Dried mushroom

According to the findings of a survey by Mac-plan India, about 55% of the households out of 354 samples from 29 major cities of 15 states of the country were the regular consumers. Highest level of consumption was about 60% in the Northern Region, while the lowest was 20% in the Eastern Region. Consumers with income ranging between Rs.10,000 and Rs. 35,000/- were the major consumers i.e., between 19-22%. Supply and Price trend of mushrooms were inconsistent affecting consumer demand. It is estimated that demand-supply gap by 2006 will be around 1,26,000 MT/year which clearly denotes a vast scope to expand mushroom enterprises.

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Due to highly perishable nature preservation of mushrooms is necessary to minimise the post harvest losses,. For this, the processing techniques such as Canning, Individual Quick Freezing (I.Q.F.), Vacuum Freeze Drying (VFD), Drying, Vacuum Drying, Pickling, Steeping Preservation, Radiation Preservation etc. have been developed. These are used on the basis of their merits per se market demand and end use.

Canning is an established process of preserving mushroom pieces in brine, butter, oil, vinegar etc. It involves six basic operations like cleaning, blanching, can filling, sterilization, cooling and labelling. Through all these operations, mushrooms are graded, cleaned, blanched (pre-cooked), filled in brine solution of cans and ultimately sterilized with heat and cooled through water spray and labelled for storage. Canned mushrooms form major share of world trade.

Individual quick freezing is another popular processing method followed in large industrial units. In this process, raw materials are washed at processing units after receipt from farms, and then the mushrooms are inspected, sliced and graded according to quality. After that, blanched and water cooled mushrooms are subjected to tunnel freezing stage. At this stage, these are cooled in a system having temp - 40°C and the core areas of mushroom pieces acquire a temp around - 18°C. Subsequently, packed in multi-layer polybags and stored in a cold storage having temp -20° to -25°C. Vacuum freeze drying (V.F.D.) is a further development in mushroom processing technology. In this process the original shape, quality, colour size, texture, freshness properties of

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thermal sensitive produce are retained. This processing technique involves the cooling of mushroom much below the freezing point i.e. -40°C where moisture present in mushroom is converted to tiny ice molecules which further directly sublime into vapour when subjected to vacuum with a slight rise in temp resulting a dried end product.

Drying is the age old practice of preserving mushrooms at ambient temperatures. With the advancement of technology, different kinds of dehydration processes have been developed e.g. Sun drying, mechanical drying, air drying, micro-wave oven drying, etc. Among these the microwave oven drying is the best method. Vacuum drying process is followed in reduced pressure. In this process, the produce is subjected to a vacuum drier in which steam is present at about 1.0 to 1.5 bar. A vacuum pump is used to reduce pressure inside the product. The end product is obtained after completion of vacuum drying process.



Drying of mushroom

Pickling of mushroom is also a popular method of preserving. It is a more economically viable way during the surplus periods. By this process, mushrooms and different spices/condiments according to preference are fried separately. After that these are allowed to cool and filled in bottles/containers.

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In case of steeping preservation, mushrooms are preserved by steeping in a solution having 10-12% salt whereas the Radiation preservation of mushrooms is done by radiation with Gamma rays at the dose of 100-150 Krad to stop the post harvest growth and discolouration/deterioration of mushrooms.

The major importing countries are U.S.A., Canada, Germany, Netherland, France, Switzerland, Japan and Malaysia. Earlier, major quantity of mushroom was exported in preserved/processed form but of late the scenario is changing. Fresh mushrooms are preferred over preserved ones in EU and American countries. Till mid 90s, the entire production of mushrooms was consumed domestically. M/s. Ponds established a 100% EOU at Ooty which was exporting the packed mushrooms to USA. In 1994-95, some firms started using such techniques. High tech machinery with environmental control equipment were imported and mushrooms produced were canned and exported to Europe and USA. However, the entry of India in International market coincided with the crash of prices for mushroom in international markets because of competition from China. China was the leading exporter. However, the strong presence of China in market of U.S.A. was reduced due to imposition of anti-dumping duties by U.S.A.

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In the present circumstances when anti dumping duties favoured India and prices have improved, the country stands a good chance if we view the (SWOT) – Strength, Weaknesses, Opportunities and Threats, analysis of Indian mushroom industry, the following picture emerges:

■ **Strength:**

1. Climatic conditions congenial for mushroom production.
2. Abundant raw material, technical pace, cheap manpower, enormous domestic market coupled with government support.
3. Strategic location.

■ **Weaknesses:**

1. Higher cost of finances, packing material, energy and transportation.
2. Poor quality of raw materials, high value of plant and machinery and heavy duties.
3. Operational restrictions of 100% EOU.

■ **Opportunities:**

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1. Decline in production of mushrooms in other countries, breaking down of international trade barriers.
2. Well adapted modern technologies for production and post harvest management.
3. Increasing awareness and liking for mushrooms in domestic market (27,865 tonnes consumption in 1996-97).

■ **Threats:**

1. Fierce competition from China.
2. Demand shift towards fresh mushrooms.
3. GATT/URAA

India can export about 50% of it's production but due to lower allocation of quota for Indian mushroom in E.U. countries, lack of campaign for establishing Indian mushrooms in international market and exploitation of new foreign markets, specially nearby markets of middle east etc. are coming in the way to achieve the same. However, some corporate sectors units are making tie-up arrangements with American companies to tap the North American market.

The serious efforts in commercial research on mushrooms is of recent origin. It was started during 1886 by N. W. Newton, but the organised efforts were started during 1939 at Chennai. Subsequently remarkable progress in research was achieved during 1961 with the launching of a scheme on mushrooms at Solan (H.P.) by ICAR and H.P. Govt. Later, the research work got further momentum with the starting of UNDP project in H.P. during 1977 and subsequent establishment of National Research Centre for Mushroom (NRCM) at Solan (H.P.) during June, 1983. The focus was on development of suitable low cost compost, disease resistant high yielding spawns, new varieties and educating the growers.

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However, still it is felt that proper harvesting techniques are to be developed. Growers at small / household levels are to be trained for efficient production as well as post harvest management / practices etc. The transportation cost in hilly areas need to be subsidised and the refrigerated vans should be provided to minimise losses during transport of highly perishable fresh mushrooms. In order to protect small farmers from the exploitation by middlemen, an efficient marketing system with a centralised procuring and processing units may be set up surrounding the potential/ growing areas.

Mushroom enterprise is a capital-intensive venture. Financial assistance is available from NABARD, State Govt financial institutions, public sector banks but with a high rate of interest. Besides this, different incentives are also available from Department of Food Processing Industries, NHB, and State Govt. agencies engaged in agricultural development. Generally, small growers are unable to avail of these facilities and therefore they may unite to form cooperatives or SHGs for better marketing and solving their problems.

The mushrooms of Himachal Pradesh should be established '**As a quality produce of India**' in foreign markets to exploit present declining trend of mushroom production in many producing countries. In addition to that, the growers' cooperatives/SHGs should also try to maintain the qualities to the international standards as well as explore the possibilities of exporting fresh mushrooms to nearby Middle East and southeast regions. For proper expansion of mushroom enterprises, sincere efforts are also to be made by traders, growers cooperatives, SHGs and Central/ State Govts, agencies to exploit vast domestic market by popularising the consumption of mushrooms as most nutritive, purely vegetative produce.

RECOMMENDATIONS

The mushroom industry has the potentiality to contribute significantly for economic growth in Indian agricultural sector and horticultural scenario of Himachal Pradesh, but it could not materialise to the desirable extent owing to some bottlenecks at different levels. Hence, an effort is made to suggest the possible measures to address the same. The problems and remedial measures are categorised as follows:

GENERAL:

- 1) The mushrooms are highly nutritive food and have certain medicinal properties also and hence can be used by healthy and patients alike. The per capita consumption in India is meagre 20-25gm. as against 3.83 kgs. in Germany, 3.35 kgs. in U.K., 3.80 kgs. in Ireland and 2.60 kgs in Italy. Furthermore, it can also generate good income for producers. However, both the consumers and producers are not fully aware of its virtues.
 - i) There is an urgent need to make use of all the available media to educate both the target groups. Mushroom festivals or mushroom pavilions can be arranged in all the important exhibitions and fairs. Mushroom Fairs are organised at NRCM Campus. NRCM also participates in Kisan Melas and exhibitions.
 - ii) Help of doctors, dieticians and NGOs may be sought to popularise it by campaigning the benefits of mushrooms as a good nutritious diet and circulation of free recipe books.
 - iii) A National Advertising campaign by Trade, Growers Co-operatives, SHGs or Central/State Organisations to develop domestic trade, is the need of the hour to popularise virtues of horticultural crops and encourage consumption of nutritive mushrooms by Indian population.
- 2) The strategy of involving housewives through training programmes and supply of subsidised quality planting material to them for increasing the production of mushroom and additional income to the weaker sections may not yield the desired results. The reason gathered is that generally minimum quantity fixed in buy back system is 50 kgs.

Since, it is difficult to achieve this quantity by an ordinary house wife, either the minimum buy back quantity should be fixed at practical levels or the ladies may be encouraged to form a co-operative with special attention for synchronising the harvesting period.
- 3) Though the hilly regions are more suitable for cultivation due to cooler climate, the problems of marketing, transportation coupled with short shelf life negate the advantage. Development of infrastructure in such producing areas requires special attention. Transport can be subsidized at least initially in such hilly regions.
- 4) Fragility of marketing system in respect of wild growing mushrooms is an important constraint. The seasonality and wide fluctuation in collection results into erratic procurement and supply. The collection may be organised by farming co-operatives or by NGOs/Traders.

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- 5) Drying techniques for export of wild growing mushrooms have not made any adjustment to export market. People engaged in collection of wild mushrooms may properly be educate/trained.
- 6) Lack of market/consumer acceptability for new mushroom varieties in domestic market and its potential in export market. Varieties other than white button mushroom are to be cultivated. Growers of Himachal Pradesh state should avail the advantage of favourable agro-climatic conditions of the state and exploit the potentials of other fast growing mushroom varieties instead of concentrating on white button mushroom only. Price incentives may also be given for cultivation of varieties other than white button mushroom. Growers of tropical/sub tropical climate area may grow paddy straw mushrooms (*Valvariella spp.*), oyster mushroom (*Pleurotus spp.*) as these require less monetary inputs with simpler production technology.

GROWERS :

- 1) Mushroom cultivators are unorganized. Hence due to low operating level they suffer with high cost for electricity, temperature, humidity conditions and transportation, lack of financial resources and technical inputs. Growers should unite to form cooperatives; S.H.Gs or some NGOs/traders should come forward to their rescue with contract farming or backward linkage arrangement. The cheaper and locally available raw materials (saw dust etc.) should be tested to utilise them as substrates. Separate facilities complete in all respects and having strong R&D laboratories should be made available for manufacture of compost and casing soil. A technical collaboration with any established institute or reputed manufacturing unit is also advisable.
- 2) NGOs/Traders or NRCM may supply disease resistant, high yielding varieties of superior stains and improved technologies for higher yields at no loss no profit basis. Growers should be well versed with proper cultivation technology as the productivity depends on proper monitoring and controlling the temperature, humidity and hygienic conditions.

R&D institutes situated around Solan (H.P.) are capable of imparting training whose services can be availed by growers. The H.P.state /NRCM may also have collaboration with foreign institutes viz -

- i) IPC plant/Mushroom growers training centre and Mushroom Experimental Station at HORST, Netherlands.
 - ii) Mushroom Research Centre at Penn State University P.A.USA .
 - iii) Centre Technique du Champignon Tours, France etc to educate the growers regarding the requirements of foreign buyers and technologies adopted there for promotion of mushroom export from H.P .
- 3) A number of insects, nematodes and parasites affect the production. Complete hygienic conditions, by use of chemicals like 5% centrabride formaline, 0.05% melathion or 0.03% Newran is needed to be maintained.

- 4) Mushrooms are attacked by fungi, bacteria and viruses. For controlling the diseases, the maintenance of proper humidity, taking prophylactic measures and use of chemicals viz dithene Z-78 0.25% for convane, spray of 0.25% dithene M-45 for dry bubble etc. are recommended.
- 5) Due to absence of proper harvesting techniques estimated loss during harvesting is upto 20%. Adoption of proper harvesting technique is essential.
- 6) Farmers face the problem of getting a remunerative price due to their non involvement in marketing. Farmers may form co-operatives. or pool their produce for better, cost effective marketing. Mushroom growers may also participate in direct marketing to consumers on the lines of Apni Mandi or Rythu Bazars or by selling the produce in " Mobile Cold Carts ". In the beginning low budget ice cream carts can be used.

TRADERS/EXPORTERS:

- 1) Some target markets of urban, semi-urban, metro cities are to be targeted which are situated within/nearby the state and having health conscious middle and higher income groups of people.
- 2) The existing packing of mushroom is in poorly printed, shabby poly-pouches. It should be changed to packages of cushioned laminates or over wrap trays and other attractive packages. The environment friendly, recyclable or bio-degradable packaging materials having an eye appeal like '*traffic light system*' packages can also be used for further betterment of mushroom trade.
- 3) Well organised distribution network of processing units, cold storages, refrigerated transport, retail chain systems connected with supermarkets on the pattern of Mother Dairy distribution system should be evolved for efficient marketing and export of mushrooms.
- 4) False notion in the minds of international buyers that Indian mushrooms are produced under unhygienic conditions results in non-acceptance. All out efforts should be made to drive out this false notion by inviting foreign buyers and "***Mushrooms--the produce of India***" should be established in international market. However, adoption of new controlled environment technology is creating confidence in the minds of foreign buyers and exporters. More E.O.U.s. with technical and financial tie up and buy-back arrangements with foreign firms shall address the problem.
- 5) There is a good potential to increase our share in USA market where Indian mushrooms are well accepted. India's share increased from about 2% in 1992 to 6.14% in 1997. The share of Hong Kong and Taiwan drastically decreased from 17.2% and 9.88% to 1.34% and 4.05% respectively during the same period. Mushrooms exporters should also explore the possibilities of exporting mushroom to Middle East Region.
- 6) There is a shifting of preference from preserved to fresh mushroom in international markets. Indian exporters should take note of this shift and equip themselves for this changed preference. Due to highly perishable nature there may be problem in exporting to very distant market. However, the Asian markets specially Middle East Region needed to be explored.

- 7) There is apparent trend of declining production and increasing demand in some countries. Indian traders need to avail this opportunity in establishing "**Indian Mushroom**" in international market.
- 8) Traders may make use of recommendations of researchers for improving the shelf life of quality by use of chemicals such as 125 ppm ethylene diamine tetra-acetic acid and 0.1% veradix, vipul and ascorbic acid.

PRESERVATION AND MARKETING :

- 1) Area of value addition in mushroom has not received due attention till now. Performance of growing and processing units is far from satisfactory. Hence, growers should be trained for efficient production and post harvest management practices like preservation/ processing, marketing, storage etc.
- 2) In order to extend the benefits of processing to the small/medium growers, a centralised multi agri. processing unit could be set up by any Govt. organisation/co-operative societies around an area having good number of small mushroom growers.
- 3) Lack of efficient marketing system for mushroom is a major bottleneck. Public Sector Undertakings, various processing and export organisations, well organised retailers like super markets, chain vegetable stores, Mother Dairy / Safal retail chain systems should come forward for efficient marketing and export of mushrooms.
- 4) Efforts should be made to produce the crop through out the year by controlling temperature and humidity so that the supply is maintained throughout the year.

ROLE OF CENTRAL, STATE AND OTHER ORGANISATIONS INCLUDING NGOS:

- 1) In order to extend the benefits of mushroom ventures to the small/medium entrepreneurs, more and more co-operative units should be encouraged by different Govt./Semi-Govt. organisations.
- 2) These cooperatives may also venture in processing, cold storage, refrigerated transport and well-organised distribution network.
- 3) The transportation cost in hilly areas of Himachal Pradesh state/other states should be subsidised at least in the beginning till the trade establishes.
- 4) Govt. intervention is needed to obtain more exclusive quota, price stability, freight subsidy, etc. Sincere efforts should be made to obtain unutilized quota of Poland from E.U countries.

- 5) The Agri/ Horticultural Departments of Himachal Pradesh State should initiate more extension programmes for growth of mushroom enterprises in this state. The effort should be two pronged-
- i) Consumer motivation by exposure to various types of fresh mushroom, preserved mushroom. Small quantity packages of pickles, recipes may be sold or freely distributed among people informing their nutritive value.
 - ii) Producer's awareness –
 - a) Latest consumer preferences in national and international markets.
 - b) Various schemes of different state and central govt. organisations for the benefit of concerned.
 - c) Latest developments in the field of production, shelf life extension , processing and research work.

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- 6) Mushroom industry is a capital-intensive enterprise, Earlier, financial institutions were reluctant to lend the money to growers, only limited sums were being lent to small seasonal growers. But now the National Bank for Agricultural and Rural Development (NABARD), the state government financial Institutions, public sector banks are coming forward to finance ventures of even crores of rupees. However, sometimes, growers cannot avail these opportunities due to high rate of interest. Hence, due attention is to be given to provide more and more loan facilities to the growers at cheaper rates of interest.

Different types of financial assistance and soft loans are also available from N.C.D.C., National Horticulture Board (N.H.B.), A.P.E.D.A., State Govt. Agencies responsible for development of Agriculture and Agro-based ventures. The incentives available include reduced rate of interest on term loans, liberal financial assistance for developing strong R & D facilities, providing subsidies on marketing and market promotion expenses and development of strong trained manpower base and strengthening backward linkages. However, MOUs are not permitted to avail NHB and APEDA soft loan due to limit of Rs. 1 and Rs. 4 crores. Hence, suitable measures are needed to be adopted at appropriate levels to overcome these bottlenecks.

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