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# Cultivation of reishi (*Ganoderma lucidum*) and shitake (*Lentinula edodes*) mushrooms

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**Reishi mushroom (*Ganoderma lucidum*) :** Reishi mushroom is pharmacologically as well as commercially the most important medicinal mushroom in the world. Reishi is reported to possess a plethora of very significant medicinal values- anticancer, anti HIV, antiheart attack (cholesterol lowering as well as anti-angiogenic), Hepato- and nephrotoprotective, hypoglycemic (anti-diabetes), antioxidants etc.

**Cultivation technology:** Reishi can be grown by the farmers seasonally in the low cost growing rooms preferably polyhouse and also in the environmentally controlled cropping rooms by the industrialists. As the mushroom is intended to be used exclusively as medicine, it has to be grown organically; seasonal farmers have to put up polycover on the aside top and sides of the thatched huts and utmost hygienic conditions have to be maintained to prevent diseases and pests as no toxic chemical is to be used for controlling the same.

Reishi is grown on the saw dust of the broad-leaved trees (mango, poplar, coconut, sheesham). Sawdust, obtained from the saw mills, is amended with 20% wheat bran and is wetted to a level of 65% moisture. Calcium sulphate (gypsum) and calcium carbonate (Chalk powder) are added to get a pH of 5.5. The mixed substrate (700 g dry wt; 2.1 kg wet) is filled in polypropylene bags the mouth of which is then plugged with cotton after putting a plastic ring exactly like wheat grain spawn pack of mushrooms in polybags.

The bags are then sterilized in autoclave at 22 p.s.i. for 2 hrs. After cooling, the substrate is spawned with wheat grain or saw dust spawn @ 3% on the dry weight basis, as it is comparatively a slow growing fungus. Spawn run (incubation) is done at 28-35 °C in the closed rooms (high carbon dioxide) and darkness. After the complete spawn run (bags white all over), which takes about 25 days, polythene top is cut at the level of the substrate totally exposing the top side and proper conditions for fruiting or pinning (temp. 28 °C, 1500 ppm $CO_2$, 800 lux light, 95% RH) are provided.

Once the pins have grown up enough to form the cap which is indicated by the flattening of the whitish top of the pinhead, humidity is reduced to 80% RH and more fresh air is introduced (1000 ppm $CO_2$). Once the cap is fully formed, which is indicated by yellowing of the cap margin (which is otherwise white), temperature is lowered to 25 °C and RH is further reduced to 60% for cap thickening, reddening and maturation of the fruit bodies.

Full maturity is indicated, when the cap is fully reddish brown and spores are shed on the top of the cap (see the photograph). Harvesting is done by the tight plucking, holding the root with one hand and pulling up with another; scissors and knives can also be used but no residual bud is left after harvesting. One cycle of the growing takes 10-15 days. After harvesting the first flush, conditions for pinning are again switched on (*i.e.* 28 °C, 95%RH, 1500 ppm $CO_2$, 800 lux light) for staring and completing the second flush. Depending upon the conditions, 2-3 flushes appear and a total 25% B.E. can be achieved (250 g fresh mushroom from one kg dry substrate). One crop takes about four months.

Harvested mushrooms, after washing with water, are dried at low temperature (<50 °C) in the cabinet driers, preferably at 35 °C in the dehumidifying cabinet drier. Freeze drying is, however, the best. Reishi mushroom has very high dry matter (45% *i.e.* 450 g dry from 1 kg fresh).

**Marketing:** Reishi is used as medicine and not as food because it is bitter and corky hard. Any one growing it has to find the market which is basically herbal medicine and food supplement (nutraceuticals) sector. Manufacturers of herbal medicines and food supplements can process, pack and trade it in various forms capsules, tablets, liquid extracts or even Reishi.

The cultivation technology of the medicinal mushroom *Ganoderma lucidum* commonly called as Reishi mushroom has been standardized on locally available substrates. The flow chart of the technology is as follows.

**Shitake mushroom (*Lentinula edodes*) :** Shitake mushroom is the most important culinary medicinal

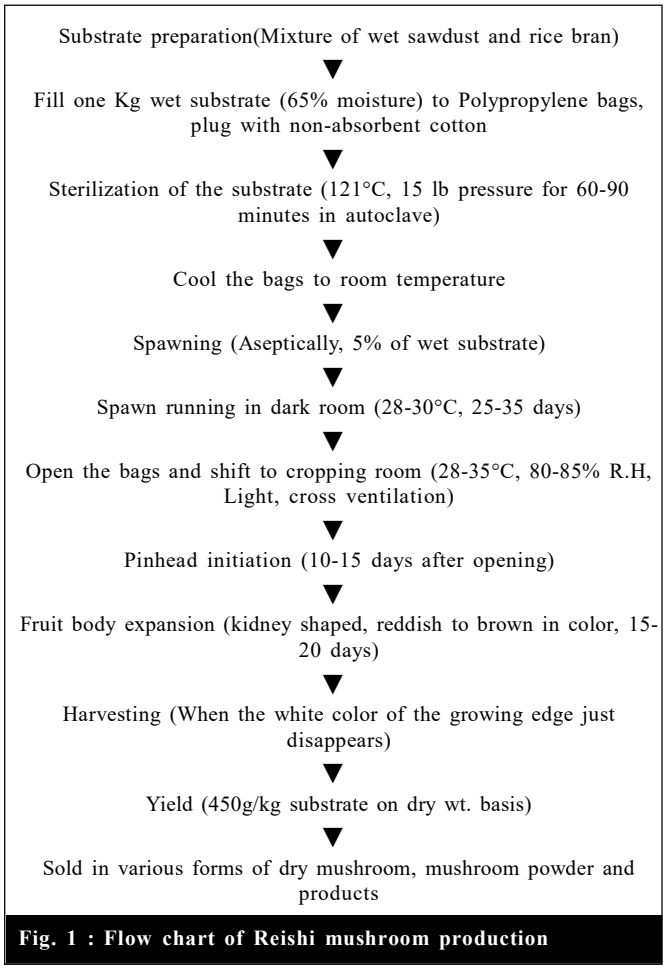


**Fig. 1 : Flow chart of Reishi mushroom production**

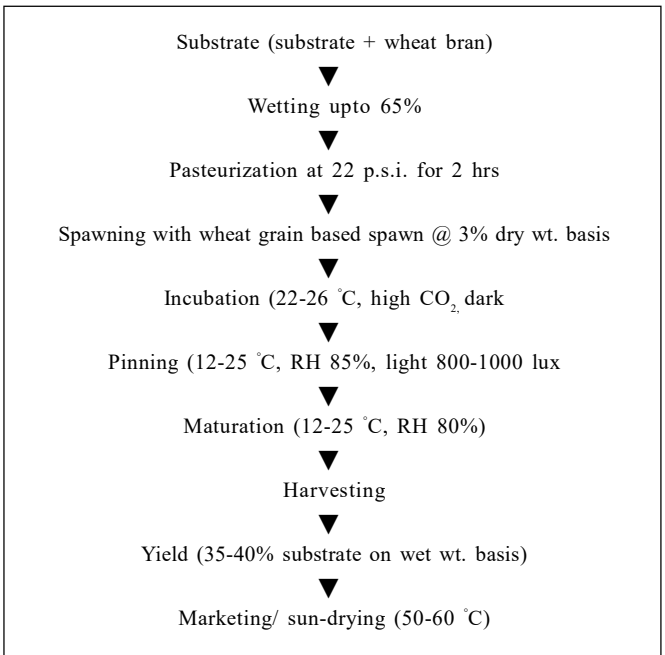


**Fig. 2 : Flow chart of shiitake cultivation**

mushroom. In the world, it ranks second in terms of production after button mushroom. Shiitake is a prized mushroom with a delicious taste, texture and medicinal values.

**Cultivation technology:** The commercial cultivation can be carried out on sawdust of broad leave trees mainly mango, safeda, oak, maple and poplar using saw dust (80 kg), wheat bran (19 kg) and calcium carbonate (1 kg). Water should be adjusted to 60-65% and pH to be adjusted to 5.5-6.0 using gypsum. Saw dust is soaked for 16-18 hours and wheat bran for three hours. All the ingredients are thoroughly mixed.

**Filling and sterilization of bags:** Fill the bags (1.5 to 2 kg) immediately after mixing all the ingredients. Otherwise fermentation and contamination may start. Polypropylene (heat resistant) bags are used for filling. The bags are first loosely filled and later pressed to get cylindrical shape. After filling the bag PVC or iron ring is inserted at the mouth of the bag and plugged with non-absorbent cotton. Sterilization is carried out in an autoclave at 22 psi for 1.5-2 hours.

**Spawning and Spawn running:** Spawning is carried out by removing the cotton plugs. Grain spawn is introduced @ 3% (dry wt. basis) under aseptic conditions. After inoculation bags are placed in cropping rooms where these are incubated in a 4 h/ 20 h light/ dark cycles at 22-26°C. Spawn run may take 60-80 days or more depending upon the strain and environmental conditions. During the period it goes through mycelial growth, mycelial coat, mycelial bump, pigmentation/browning and coat hardening phase.

**Mycelial coat formation:** A thick mycelial sheet coat will develop on the surface of the substrate. This will be formed after 68 weeks of inoculation/spawning.

**Mycelial bump formation:** Bumps are clumps of mycelium, commonly formed on the surface of most strains after 9-10 weeks. These bumps can turn into mushroom primordia at a later stage but most of them abort. Fluctuating temperatures and high $CO_2$ promotes bump formation.

**Pigmentation:** Some aeration should be provided when the bumps have formed. After longer spawn run the surface of the colonized substrate may begin to turn brown, some exudates may also be there during spawn running.

**Coat hardening phase:** Remove the polypropylene bag when synthetic log has partially (half or one third) turned brown. The coat will gradually become hard and outside of the substrate should also be hard while the inside should be softer and moist. The core of the substrate has moisture of about 80%.

Fig. 4 : *Lentinula edodes*

Fig. 3 : *Ganoderma lucidum*

**Fruiting:** For induction of fruiting suitable temperature, high RH, good ventilation and cold water/ shock treatment are required. After 5-8 days of cold-water (4-6°C) treatment for 10-20 minutes, initiation of primordia begins. The fruit bodies further develop and became ready to harvest in next 5-7 days.

**Harvesting:** Take the stalks of the mushrooms and break them from the substrate. Don't tear them from the surface. Harvest the mushrooms at an early stage. Normal yields are 35-45% of the wet weight of the substrate.

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