

prescribe mixing of broth cultures containing more than $100 \times 10^6 \text{ ml}^{-1}$ rhizobia in carrier, counts obtained in jaggery solution were quite high for preparation of carrier-based inoculants. Jaggery is cheap and easily available locally in India. Its use as an alternate of YEM broth in commercial preparation of inoculants will considerably reduce the cost of production.

27 April 1988

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APPLE POMACE — A GOOD SUBSTRATE FOR THE CULTIVATION OF EDIBLE MUSHROOMS

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HIMACHAL Pradesh produces 0.2 to 0.3 million tonne of apple every year. Apple damaged by hail storm and of inferior quality (small-sized) is mainly used for the extraction of juice by the Himachal Pradesh Horticultural Produce Marketing and Processing Plant at Parwanoo and Jarol. After juice extraction the pulp is partly used for cattle feed, whereas large quantities are thrown away. It sometimes causes pollution due to the release of offensive smell especially in humid weather. During December, 1986 profuse growth of *Pleurotus* fruit bodies was observed on rotting pomace at Parwanoo in nature. The specimens were collected for laboratory study. On microscopic examination these were identified as *Pleurotus membranaceus* Masee and *P. euosmus* (Berk. apud Hussey) Sacc. Both the species are reported to be edible. Only the salient features of *P. euosmus* are given but *P. membranaceus* is fully described.

P. membranaceus Masee

Pileus white, thin, fleshy, 4–12 cm in diameter. Epicutis made up of thin- and thick-walled parallel repent hyphae which are 6–9 μm broad. Stipe lateral, short, 0.5–1.5 \times 0.6–1 cm, trama consisting

of thin- and thick-walled hyaline, 3–7 μm broad hyphae. Lamellae decurrent, thin, densely crowded, slightly interconnected towards the stipe, unequal with 4–5 sets of lamellulae. Hymenophoral trama irregular, made up of thin- and thick-walled hyaline, 4–8 μm broad hyphae, edge fertile. Subhymenium cellular, 8–11 μm in breadth. Basidia tetrasporic, clavate, 25–30 \times 5–6 μm , sterigmata conspicuous, 2 μm long. Basidiospores hyaline, cylindrical, smooth, 7.5–9 \times 3–4 μm , Cheilocystidia ventricose, 22–30 \times 3.5–5 μm . Hyphal system monomitic with thin- and thick-walled non-inflating generative hyphae, clamp connections prominent.

It was originally recorded from Pune in 1901 by Masee¹, while Watling and Gregory², and Sohi (Aon³) collected it from Jammu, on dried stems of *Euphorbia royleana*.

P. euosmus (Berk. apud Hussey) Sacc.

Pileus spathulate becoming flabelliform, 1.5–3 cm, pinkish. Pileal trama consisting of thin- and thick-walled, hyaline 5–9 μm broad hyphae. Stipe lateral, short, 0.4–1 \times 0.3–0.5 cm, concolorous with pileus. Lamellae decurrent, light pink, thin, unequal with 4 sets of lamellulae. Basidia tetrasporic, clavate, hyaline, 19–25 \times 3.5–5.5 μm . Basidiospores hyaline, cylindrical, smooth, Cheilocystidia clavate, hyaline, 21–35 \times 5–8 μm . Hyphal system monomitic with thin- and thick-walled generative hyphae, clamp connections in all hyphae.

It was recorded in 1856 by Berkeley⁴ from Sikkim while Singh and Rajarathnam⁵ reported it from Mysore in 1977. The present record on apple pomace shows its natural occurrence in Himachal Pradesh also.

The artificial cultivation of different *Pleurotus* species was tried on six-month-old dried apple pomace, steeped in carbendazim (50 ppm) and formalin solution (200 ppm) for 18 h followed by autoclaving in polypropylene bags at 1.4 kg/cm² for half an hour. Individual bags were spawned with grain spawn of *P. sapidus*, *P. sajor-caju*, *P. membranaceus*, *P. ostreatus*, *P. flabellatus*, *P. fossulatus* and *Auricularia mesentrica*. These were then incubated at 25 \pm 2°C for mycelial spread. Complete spawn run was obtained in 20 days in *P. sajor-caju*, *P. sapidus*, *P. membranaceus*, *P. ostreatus* and *P. flabellatus*, while it took 30 days in case of *P. fossulatus* and *Auricularia mesentrica*. Afterwards bags were exposed from the top for fruiting. A relative humidity of 65–70% along with a temperature of 24–27°C was maintained in the

cropping room. Fruit bodies were harvested periodically and the yield of each species was recorded for 4 weeks.

Amongst all the *Pleurotus* species, *P. membranaceus* gave the highest yield with a biological efficiency of 48% followed by *P. sapidus* (40%), *P. ostreatus* (39%), *P. flabellatus* (36%), *P. sajor-caju* (32%) and *P. fossulatus* (10%). It was 20% in *Auricularia mesentrica*. The mycelial growth on pomace was very profuse and thick as compared to wheat straw substrate with larger and thick fruit bodies weighing up to 15 to 20 g each, especially in case of *P. ostreatus*.

Apple puree was used by Molliard⁶ for the artificial cultivation of *Morchella esculenta* while Chu and Ho⁷ could induce sporophore formation in tissue cultures of mushroom by the addition of cooked apple extract in the medium.

Various agricultural and industrial waste materials including wheat and paddy straw; maize, sorghum and pearl millet stalks and leaves; cotton stems and leaves; shelled maize cobs; dried stems of *Euphorbia royleana* and *Sesbania* and dried haulms of peas, french beans and brassica⁸; cassia substrates after extracting laxatives from fruit and leaves⁹; fibrous mill sludges¹⁰ and coffee by-products and citronella bagasse¹¹ have been used for the cultivation of oyster mushroom. Apple pomace was found suitable for the cultivation of *Pleurotus* species with a biological efficiency ranging between 30 and 40%.

The present study offers a viable alternative use of apple pomace for mushroom cultivation along with its effective disposal avoiding pollution.

Thanks are due to Shri R. S. Rana, Managing Director, HPMC and Horticultural Advisor to H.P. Govt. for his keen interest and for providing experimental material.

8 January 1988; Revised 27 April 1988

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A NEW BROWN SPOT DISEASE OF OYSTER MUSHROOM CAUSED BY *PSEUDOMONAS STUTZERI*

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MUSHROOMS are considered as delicious vegetables rich in protein and vitamins¹. Oyster mushroom (*Pleurotus sajor-caju* (Fr.) Singer.) is becoming popular in Southern India especially in Karnataka and Tamil Nadu. Oyster mushroom is cultivated on a variety of undecomposed organic substrates and generally using paddy straw². Alan *et al.*³ reported a *Pseudomonas* yellow blotch disease on the heads of oyster mushroom. The occurrence of severe dark brown patch on paddy straw which produced Brown Spot on the substrate during spawn running stage was observed in the mushroom bag (figure 1). This caused considerable damage to the mushroom crop. Therefore, a study was conducted to determine the economic loss due to the disease.

The study was conducted in four mushroom farms, viz., Lingiah Mushroom Farm, Gangenahalli, Bangalore; Main Research Station, UAS, Hebbal, Bangalore; Varanasi Mushroom Farm, Adyanadaka, South Kanara; Vikky Mushroom Farm, Anandnagar, Bangalore, to determine the average per cent infection and yield loss in Karnataka. The study indicated that infection ranged from 27 to 37% and a maximum in the case of Lingiah Mushroom Farm (table 1). Variation in the severity of the disease in different mushroom farms is attributed to the management practices in the mushroom houses. The Brown Spot infection of the substrate during spawn running stage caused significant yield loss ranging from 27 to 61% (table 1) which was maximum in Lingiah Mushroom Farm. The mushroom farms which maintained better hygienic conditions and production technology harvested higher yields.

Further, isolation and identification studies of the microorganism causing this Brown Spot disease