

Prospective of the Cultivation of New Culinary–Medicinal Mushrooms in Israel on Agro-Industrial Waste

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Starting about 50 years ago, modern agricultural technology made the cultivation of mushrooms in Israel a year-round possibility, and since then mushrooms have earned an honored place at the table in Israeli homes.

The first mushrooms to be successfully cultivated in Israel were button mushrooms (*Agaricus bisporus* (J.Lge) Imbach). Until about a decade ago, these were the only cultivated mushrooms to be found in local markets. Edible mushroom cultivation in Israel has been highly developed in recent years because it does not require much agricultural land area or water. In the years 2001–2004 the production of mushrooms in Israel doubled. In 2001, 5000 tons were produced, of which 3500 were cultivated in northern Galilee, near the Lebanon border, and the rest in other parts of Israel. The average annual production growth in northern Galilee only is 15% and rising. The increase in production capacity has evolved by an increase in the size of the production plants and their numbers. Newer and sophisticated environmental and climate control systems have been employed.

The second cultivated species was *Pleurotus ostreatus* (Jacq.:Fr.) P. Kumm., the Oyster mushroom. Both species are cultivated in agro-industrial fashion using automated and controlled lighting, temperature, carbon dioxide, and humidity. The cost efficiency of these systems is low. The cultivators are seeking new mushroom species in order to receive higher revenues. They also wish to use the

same industrial plants for the new mushrooms, to maximize their returns. The market for mushrooms is also increasing and new mushrooms are accepted. Of the 40–50 species of mushrooms cultivated in other countries, only two species are cultivated in Israel.

The growing demand in the market for fresh mushrooms is accompanied by an interest in new exotic mushrooms. Studies in research institutions in Israel mainly include the general species of genera *Pleurotus*, *Lentinus*, *Morchella*, and *Lepista nuda* (Bull.:Fr.) Cooke to produce new mushrooms in cultivation beds of the button mushrooms. Among these, the cultivation of *Pleurotus ostreatus* was developed on an industrial scale. It is based on the “satellite” concept for mushroom production. This concept includes a center for substrate preparation that serves several mushroom growers and provides technical assistance to the growers. The import of mushrooms helps to meet the increased demands for mushrooms. The market of frozen and canned mushrooms in Israel is estimated at US \$20–25 million per year (or several hundred tons) and rising.

Mushroom growing is a significant tool for the restoration, replenishment, and remediation of the Earth’s overburdened ecosphere. Mycelium produces extracellular enzymes and acids that break down large molecules, such as lignin and cellulose, which are the two primary components of woody plants. Many kinds of waste material that contain ligneous material are available in Israel. Commercially avail-

able agro-industrial waste and feed meal products include cotton waste, chicken manure, corncob and corn straw, banana leaves and banana pseudostems, paper and cardboard, wheat straw, peanut shells, almond shells, sunflower shells, grape residues and pomace, alfalfa, and olive oil waste.

Research has started at Haifa University to develop commercially viable cultivation methods for highly praised culinary–medicinal mushrooms *Hypsizygus marmoreus* (Bunashimeji) and *Grifola frondosa* (Dicks.:Fr.) S.F. Gray (Maitake) for export to foreign markets and local consumption using agro-industrial waste. The local market for these mushrooms is currently recognized as small due to nonexistent and/or inefficient production systems. The main goal of the research is to achieve the highest mushroom fruit body yield, grown on agro-waste material, in the shortest time and at the lowest cost. The research methodology includes:

- A survey on local need for exotic mushrooms.
- Collecting and testing of different fungal strains known for speed of growth and fruiting (from the culture collection of culinary–medicinal mushrooms of the Institute of Evolution, University of Haifa (HAI), Israel).
- Identification of suitable *Grifola frondosa* and *Hypsizygus marmoreus* strains for commercialization, based on overall quality and ease of cultivation.
- The collection and testing of different agro-

industrial waste from local materials, for spawn run and fruit body production.

- Determining spawn run requirements and length.
- Development of liquid inoculation techniques for spawn production.
- Optimization of spawn storage.
- Establishing an effective and practical method of cultivation container and the type of heat treatment.
- Optimization of substrate composition and growth conditions including temperature, humidity, light, aeration, casing layer composition, and type of container for substrate.
- Studying the effect of certain additives on colonization and yield.
- Development of technological regulation for fruitbody production.
- Studying post-harvest handling.

Upon completion of the research, successful substrates and strains will be patented.

In conclusion, more research and development of mushroom cultivation biotechnology is required to satisfy the local demand for culinary–medicinal mushrooms.