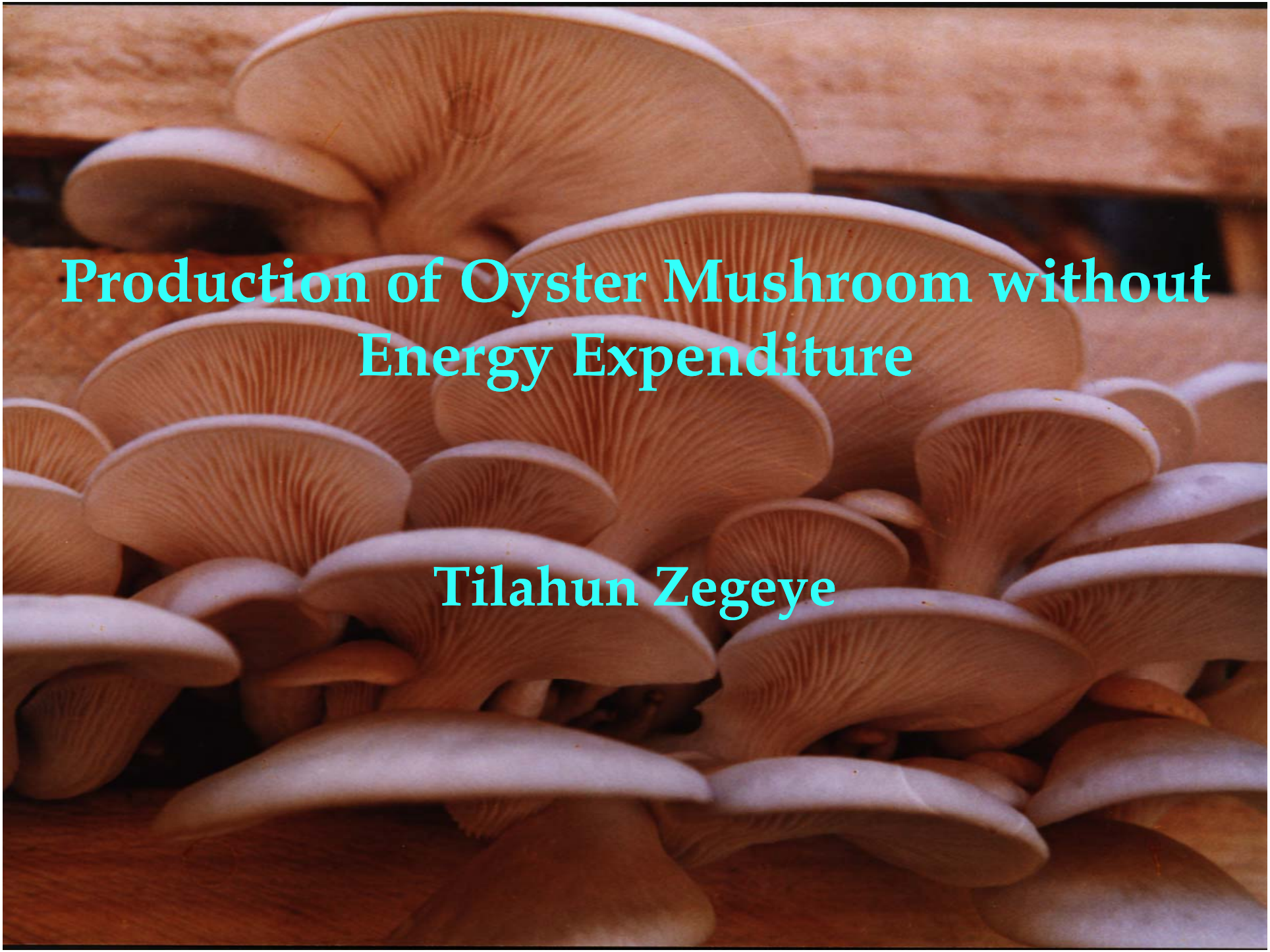

Production of Oyster Mushroom without Energy Expenditure

Tilahun Zegeye

Oyster Mushrooms

- Pleurotus sp. (Oyster mushrooms) → Order Agaricales & family Polyporacea
- Distributed in Northern Hemisphere (Europe, N. America & Asia) and some from Africa (*P.luteoalbus, P.opuntiae & P. flabellatus*)
- Saprophytic on hard woods (beech wood), in forest and wood lands → grown on felled branches, dead tree stumps, and on felled logs

- Ranks the third of commercially cultivated mushrooms(25% of total world production)

  - taste, medicinal, and nutritional properties
  - rapid mycelial growth, simple and inexpensive cultivation techniques
  - several kinds of species
  - grown on a small scale with a moderate initial investment

- Cultivated species in this genus include

P.ostreatus, P.sajor-caju, P. cystidiatus, P. cornucopia, P. pulmonarius, P. citrinopileatus & P. tuber- regium, P. flabellatus

- In Ethiopia, Oyster mushroom (*P.ostreatus, P.sajor-caju, P. pulmonarius)*

- *Pleurotus* mushrooms

- Protein, Carbohydrate, dietary fiber, Vitamins (B1, B2, B12, C, D, and niacin), mineral elements

- Medicinally, known for mevinolin (lovastatin) and compactin

  ✦ abnormal deposition of cholesterol and cholesterol-rich lipoproteins ⟶ Arteriosclerosis

- Antitumor, antibacterial, antioxidant, Immunomodulating, antiviral, anti-inflammatory etc

Growth Substrates

- *Pleurotus* species (saprophytic fungi) ⟹ on lignin and cellulose-containing substrates

- Composition, availability and utilization of cheap materials

- hard woods, wood by-products (wood chips, paper, cardboard and sawdust), and most agricultural wastes like cereal straws, bagass, rice husk, cornhusk, banana leaves, maize stover, cotton wastes etc

Substrate Preparation and Cultivation Methods

- Composting

- Steam pasteurization → chopping, mixing, wetting, and pasteurization with steam for sometime

- Anaerobic fermentation or anaerobiosis

- Cylindrical containers, plastic bags, trays, wooden or polystyrene racks, blocks etc (Fig 1)

Experiment

- Objectives were to investigate the bioconversion (biological) efficiency of Oyster mushrooms (*Pleurotus ostreatus* and *P.sajor-caju*) on fermented and non-fermented (pasteurized) Teff (*Eragrostis tef*), wheat and grass (predominantly *Andropogon abysinicus*) straws

- Compare between fermented and non-fermented substrates

Methodology

- Cultures of *Pleurotus ostreatus* and *P. sajor-caju* (Malt Extract Agar) ⟹ incubated at 22^0C for 1-2 weeks

- **Grain Spawn Production:**
  - Sorghum was cleaned and soaked overnight
  - Water was drained off and 10% wheat bran and 2% gypsum (calcium sulfate) were added
  - Distributed equally in to 500ml glass bottles & sterilized
  - After cooling, each bottle was inoculated with eight agar blocks (1cm X1cm) of 18 days old agar culture and incubated for 20 days at 22^oC

- **Substrate Preparations:**
  - Grass straw was chopped manually in to 5-6 cm in length
  - Two methods: Pasteurization and fermentation of straw
  - Straws were soaked in water
  - Excess moisture removed and pasteurized for 20-30 minutes at 80^{o}C
  - Pasteurized substrate was placed in to plastic bags (100x58 cm)

- Straw was soaked in a tank (0.92 m^3) filled with water and allowed to ferment for six days
- Substrates were taken out from the tank and excess water was drained off and placed in to plastic bags

- Bags were inoculated with 5% of mushroom grain spawn per bag
- Bags were tied at the top end for mycelium invasion

- **Spawn Run and Fruiting Body Development**
  - Spawn run and cropping in a growing house of Africa Mushroom PLC with bamboo and plastic made walls, plastic covered ceilings and sand covered floor
  - The inoculated bags on wooden shelf unit in growing room at ambient temperature (10-26^{0}C), humidity (60-85%) and natural ventilation

- Bags were opened and unfolded at the upper parts for fruiting body
- Pinholes were also made in the bags
- Water was sprayed, twice a day, on the compact mass of the substrate and mycelium
- Mature fruiting bodies were harvested

- Biological efficiency (BE) (the ratio of the weight of fresh fruiting bodies to the weight of substrate, multiplied by 100) was calculated in 75 days of cultivation
- Experiment was design as 2x2x3 factorial in a CRD with six replicates per treatment
- General Linear Models (GLM) procedure was used to perform analysis of variance
- Tukey s t-test was used to separate treatment means

Result of the Experiment

- *Pleurotus mushrooms* took 2-3 weeks to completely colonize the spawn substrate (Fig 2)
- Fermentation Broth:
  - Drop in pH from slightly alkaline water to acidic range occurred in the first phase and the later except for Grass straw (Fig 3)
  - In all cases, the fermented straw had pH in the acidic range

- In general, spawn running (mycelial development) took 6-8 weeks on the average after inoculation
- The first pinheads (Small fruiting bodies) appeared on 23.60 to 58 days after incubation (Fig 4)
- Mature fruiting body started to appear as early as 27.80 days (fermented WS colonized by *P.sajor-caju*)
- Late appearances occurred after 61.50 days (pasteurized GS colonized by *P. ostreatus)* (Fig 5)

- Highest and lowest mean yield BE ……. on pasteurized GS colonized by *P.ostreatus* (807.59 g and 44.05%) and fermented TS colonized by *P.ostreatus* (38.67 g and 2.11%),respectively (Fig 6)

☆ Effect of substrate treatment type:

- Yield and BE higher on pasteurized than fermented (Fig 7)

☆ Effect of substrate type:

- GS gave yield and BE than TS or WS (Fig 8)

Conclusion

- Higher biological efficiency was recorded on pasteurized straws……

  - considering the economics, fermenting substrates for small scale cultivation of *Pleurotus* mushrooms…….. since it excludes the pasteurization stage

- Though grass straw was found to be superior over the other straws , Teff straw is the most available and cheap substrate in Ethiopia and thus can be considered as a choice of substrate for cultivation

- Further research in areas of improving the yield of Oyster mushroom species by introducing various supplements to straw

- Oyster mushrooms, in general mushroom cultivation should be practiced in this country

→ great potential in this industry since climatic conditions are very suitable for continuous harvest throughout the season

Fig 1. *Pleurotus* mushrooms in plastic bag

Fig 2. Spawn of Oyster mushrooms (*Pleurotus ostreatus* and *P.sajor-caju*)

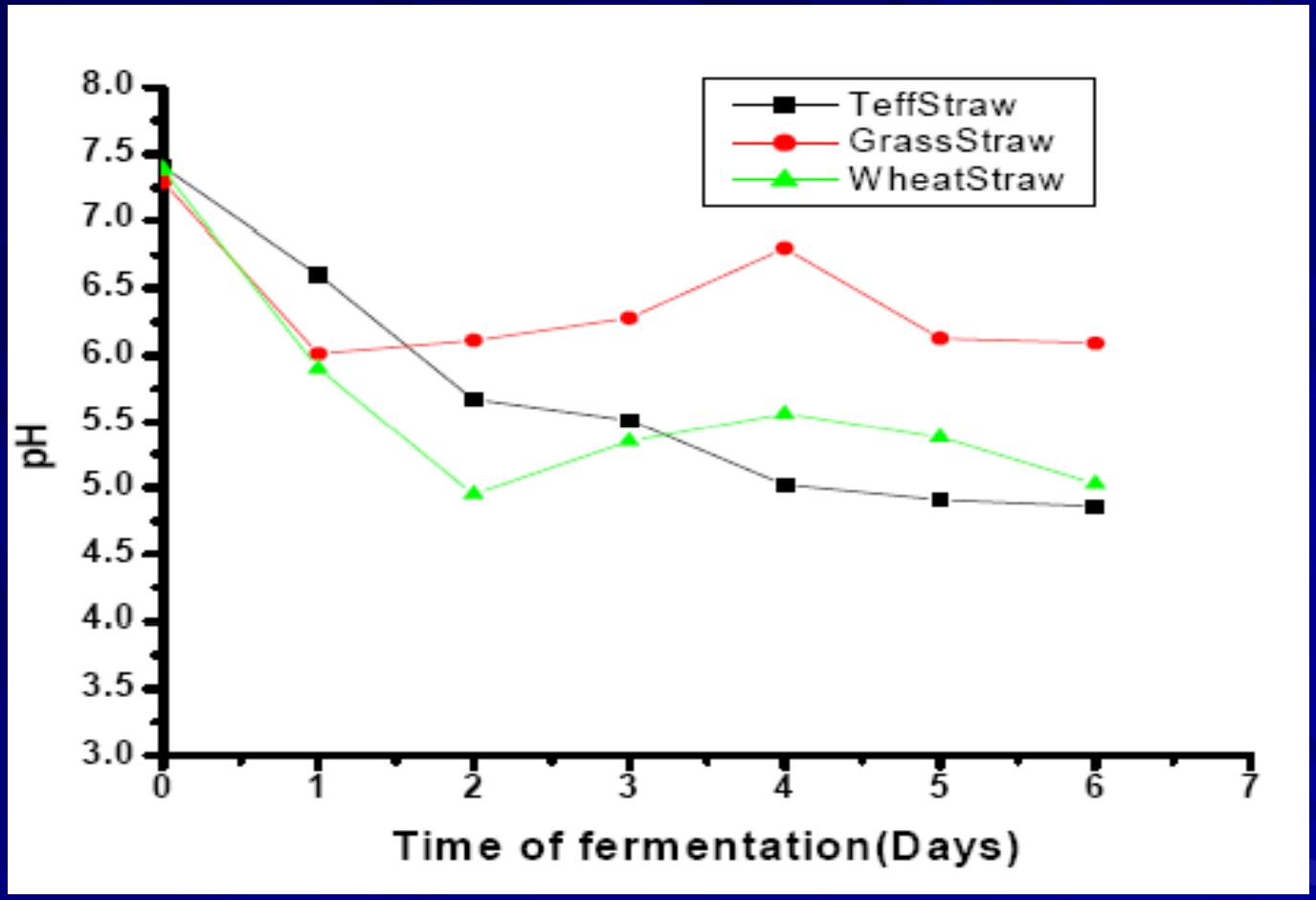

Fig 3. pH changes during natural straw fermentation

Table 7- Days for pinhead (fruiting body) formation of *P.ostreatus* and *P.sajor-caju* grown on Teff, grass and wheat straws

Mushroom Type	Type of Straw and Treatment	Average Days of Pinhead (fruiting body) Formation (Days)
Pleurotus ostreatus	Teff Straw + Pasteurization	53.67
	Grass Straw + Pasteurization	58.00
	Wheat Straw + Pasteurization	53.33
	Teff Straw + Fermentation	51.00
	Grass Straw + Fermentation	51.00
	Wheat Straw + Fermentation	50.00
Pleurotus sajor-caju	Teff Straw + Pasteurization	34.83
	Grass Straw + Pasteurization	28.33
	Wheat Straw + Pasteurization	35.33
	Teff Straw + Fermentation	24.00
	Grass Straw + Fermentation	27.33
	Wheat Straw + Fermentation	23.60

Fig 4. Days for pin head (fruit body) formation of *Pleurotus ostreatus* and *P. sajor caju* on Teff, grass and wheat straws

a- *P.sajor-caju* on Teff straw .

b- P.ostreatus on Teff straw

c- *P.sajor-caju* on grass straw

d- *P.ostreatus* on grass straw

e- *P.sajor-caju* on wheat straw

f- *P.ostreatus on* wheat straw

Fig 5- Growth of *P.ostreatus* and *P.sajor-caju* on Teff, grass, and wheat straws (a-f)

Mushroom Type	Substrate Preparation Method	Substrate Type	Mean Yield (g)	BE (%)
P.ostreatus	Pasteurization	TS	491.67	26.82
		WS	338.33	18.45
		GS	807.59	44.05
	Fermentation	TS	38.67	2.11
		WS	243.33	13.27
		GS	69.66	3.80
P.sajor-caju	Pasteurization	TS	255.00	13.91
		WS	78.33	4.27
		GS	601.34	32.80
	Fermentation	TS	234.17	12.77
		WS	240.00	13.09
		GS	365.75	19.95

TS= Teff straw, GS=Grass straw, WS=Wheat straw

Fig 6- Total yield and biological efficiency of TS, WS and GS colonized by Pleurotus ostreatus and P.sajor-caju

Method of Preparation	Mean Yield (g)	Biological Efficiency (%)
Pasteurization	407.36*	22.91
Fermentation	192.00	10.80

*= Significant at $p<0.05$

Fig 7- Effect of substrate preparation method on yield of Oyster mushrooms

Substrate Type	Mean Yield (g)	Biological Efficiency (%)
Teff straw	254.88[ab]	13.90
Grass straw	461.09[c]*	25.15
Wheat straw	141.17[a]	12.27

Note: Means in column followed by the same superscripts are not statistically different at $p<0.05$ according to Tukeys test

*= Significant at $p<0.05$

Fig 8- Effect of substrate type on yield of Oyster mushrooms