Production of Value Added Products Like Mushrooms from Distillery Yeast Sludge as Nutrient Source.

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Abstract:
This study focused on the estimation crude protein and essential factors like pH, Organic carbon and utilization of the distillery yeast sludge as source of single cell protein as substrate for growth of mushrooms. Distilleries produces yeast sludge as solid waste to a tonne of million tonnes actually, requiring disposal. Sludge consists of nutritional value and rich in vitamins, proteins, trace elements has been converted to a value added by products adopting a scientifically designed composting process. The ability and screening of the distillery yeast sludge use as rich nutritional values to grow and produce mushrooms in laboratory scale. The results shown that 1 gram of yeast sludge contains 10.79 mg of proteins, pH 5.91, Moisture changes the speed of biological activity the moisture content was estimated in the yeast sludge around 12.1%, carbon content was found around 2.9% and carbon and nitrogen ratio (C:N) affects the microbial activity and the rate of organic matter decomposition 60:1 was estimated from yeast sludge. Various percentages of Sludge with Paddy straw show mushroom growth among all substrates the mushroom span shown more growth on high amount yeast sludge.

Key words: Distillery Yeast Sludge, Single Cell Protein, Nutritional values and Mushroom span.

1. Introduction:

Distillery and sugar industries produce yeast sludge as solid waste in anticipation of discarding based on sugar cane molasses these are major industries in Asia and South America. Cane molasses are producing more than 13 million m3/year in the world [11]. Approximately 8–15 L of effluent is generated for every liter of alcohol produced. During the fermentation process of distillery industries yeast sludge refers to surplus yeast at the bottom and it also named as spent yeast or yeast slurry [16]. In India yeast sludges rarely utilized, but it is a rich amount of protein and vitamins. Several studies have been reported to utilize different microbes like fungus, bacteria, algae and yeast used various agro-industrial waste to produce various value-added products like single cell proteins and other by-products [19]. This yeast sludge is used as single cell protein dietary in the poultry industry [2]. Sludge is composed of by-products collected from during the fermentation stages and process. It contains both compounds of agricultural value (including organic matter, nitrogen, phosphorus and potassium, and to a lesser extent, calcium, sulfur and magnesium), and pollutants which usually consist of heavy metals, organic pollutants and pathogens. Sludge is usually treated, before disposal or recycling, in order to reduce its water content the presence of pathogens [12].

During the fermentation process yeast will be produced which is only partially reused for the pitching of subsequent brews. This excess yeast has a higher nutritional value after analysis and it is generally used for animal feed. Disposal of distillery sludge often presents a substantial problem. Distillery Yeast Sludge (DYS) contains a great nutritional potential to be utilized as an economical source of Single Cell Protein for poultry, because it has 27 to 29% crude protein [15]. Drying for a period of 6 h sample weight of 600 kg dried sludge have best nutritional characteristics, namely, moisture contents of 27.42%, protein contents of 22.42%, potassium contents of 5.0%, phosphorous contents of 3.6%, nitrogen contents of 3.02%, fat contents of 2.14%, ash contents of 39.93%, and fibre contents of 0.0031% resulting in the best quality of sludge to use as poultry feed and organic manure [8]. Yeast recycled paper sludge (RPS) generated 10%, increasing annually and it has an average content of 60% moisture and 50% cellulose on a dry basis. 180 and 190 g/l dry materials of Recycled paper sludge (RPS) overall 72% of cellulose getting converted into 32 and 35 g/l of ethanol after 72 hours of incubation [9]. Several researchers have been reported on utilization of distillery effluent for the production of microbial biomass.

Based on the nutritional advantages of yeast sludge consists of water, protein, fats, Carbohydrates, ash and other elements like essential elements like potassium and phosphorous and also it plays role in waste management as waste material are used as substrate [16]. Cultivation of mushrooms is found to have a high biological yield and improved efficiency and richer protein content [1]. In this we have tried to cultivate mushrooms by using yeast sludge as a suitable option for substrate.

2. Materials and Methods:

2.1 Estimation of Crude protein, Preparation of the Substrate and Inoculation: Yeast sludge was collected from one of the sugar cane industry in Mandya district, Karnataka state. An estimation of crude protein content present in Yeast sludge was done by Lowry method [7]. The substrate was prepared by using different percentage of yeast sludge and paddy straw after a pasteurization mushroom span was introduced into the substrate. These substrates were used as a source of nutrients for growth of mushroom in the laboratory and every six days the growths were observed.

2.2 Moisture content:

Water holding capacity of yeast sludge was determined by the Keen-Raczkowski Box Method by Keen & Raczkowski 1921 [5]. A simple experimental method has been described for measuring certain physical constants of soil same way physical constants yeast sludge using small brass boxes into which soil passing a sieve of 100 meshes to the inch has been packed by hand. The quantities determined like the weight of a unit volume (100 c.c.s.) of air-dry yeast sludge, or the apparent specific gravity, Amount of water taken up by a unit weight of yeast sludge, Pore space, Specific gravity of the yeast sludge and The volume expansion of unit volume (100 c.c.) of yeast sludge when saturated [20].

2.3 pH :

Yeast sludge pH was determined by preparing 1:5 sludge: water suspension and mechanically shakes for 1 hour at 15 RPM. Immersing the electrode of a digital pH meter into the sludge suspension as described by Rayment, GE & Higginson, FR 1992 [13].

2.4 Available nitrogen:

Available nitrogen in the yeast sludge was determined by alkaline potassium permanganate method as described by Subbiah and Asija. The procedures involve distilling the soil with alkaline potassium permanganate solution and absorb the ammonia liberated in boric acid which is then titrated with Standard sulphamic acid Nigam et al [10].

2.5 Organic carbon status:

Organic carbon status was determined by Walkey and Black's wet oxidation method. In this method organic carbon content of yeast sludge was estimated by oxidizing of yeast sludge. 0.5grams of the yeast sludge sample were treated with a potassium dichromate solution in the presences of H2SO4 to oxidize the organic carbon to carbon dioxide and unreacted potassium dichromate was back titrated against ferrous ammonium sulfate in presence of ferroinindicator Walkley and Black, 1934, [21].

2.6 Loss on Ignition:

Loss on ignition is a simple method for determining ash content and organic matter content of compost and manure [17]. Weigh after **h**eating silica crucibles for 1 hour at 375 ^{OC} then cool in open to about 150 ^{OC}, cool in a desiccator for 30 mins. Weigh 5g of oven dried Yeast sludge sample into the crucible. Then place the crucible containing the sample in muffle furnace, heated slowly by increasing the temperature [4, 6].

3. Results and Discussion:

The sugar industry is a major supplier of valuable byproducts and waste materials like molasses, pressmud and bagasse. Distilleries produces yeast sludge as solid waste to a tonne of million tonnes actually, requiring disposal. But it is rich in vitamins, proteins trace elements has been converted to a value added organic manure by adopting a scientifically designed composting process [14].

3.1 Yeast sludge crude protein and importance: The results shown that 1 gram of yeast sludge contains 10.79 mg of proteins. Dried yeast sludge contains 21% protein content and is also contains essential amino acids like methionine, lysine and tryptophan, which are required for growth of animals [18].

3.2 Yeast sludge pH, Moisture, Carbon, Loss on ignition and nitrogen contents:

The pH value measures the ratio of H^+ ions of OH^- base ions in the yeast sludge. If the sludge solution has more H^+ the sludge is acidic. If the OH^- more, the sludge is alkaline. The equal balance is neutral and its value 7.0. The average pH range is 5.91 found in yeast sludge solution. Beer, beverage, and food industry wastewater contain high concentrations of phosphorus, chemical oxygen demand and nitrogen [20]. To estimate sediment properties like water content, organic carbon and organic matter by loss on ignition are a common method because is the quickest and cheapest method [3]. The Overall loss on ignition average ash content was estimated 3.08% from the yeast sludge used as a substrate. Moisture changes the speed of biological activity the moisture content was estimated in the yeast sludge around 12.1% and carbon content was found around 2.9%.

Nitrogen mostly present in the form organic form in sludge and to a lesser extent under ammoniac form. Other mineral forms of nitrogen are only found as traces. The carbon and nitrogen ratio (C: N) affect the microbial activity and the rate of organic matter decomposition 60:1 was estimated from yeast sludge. Owing to its high protein content and nutritional value, the spent wash can be used as nutritional substrate for the growing of algae and fungus [14].

3.3 Mushroom growth on different concentration of Yeast sludge with paddy straw:

The percentage of 75% sludge and 25% paddy straw substrate were shown the growth of mushroom span in different time periods. The results were observed and tabulated in table 1 and image 1.

Table 1: Growth of mushroom in the presence of **75%sludge+25%paddy straws in days.**

Table 1	Sl no.	6 Days	12 Days	18 Days	24 Days
75%sludge +25%paddy straw	A1	8.5 cm	8.5 cm	8.5 cm	10.3 cm
	A2	9 cm	10.5 cm	11 cm	11 cm
	A3	8 cm	8.7 cm	9.6 cm	10.5 cm
	A4	9.7 cm	10.8 cm	11 cm	11 cm
	A5	8 cm	9.2 cm	10.5 cm	11 cm

Image 1: Growth of mushroom in the presence of **75%sludge+25%paddy straw.**

The percentage of 50% sludge and 50% paddy straw substrate were shown the growth of mushroom span in different time periods. The results were observed and tabulated in table 2 and image 2.

Table 2: Growth of mushroom in the presence of **50%sludge+50% paddy straw in days.**

Table 2	Sl no.	6 Days	12 Days	18 Days	24 Days
50%sludge +50%paddy straw	B1	7.5 cm	10.4cm	11 cm	11 cm
	B2	8 cm	9.9 cm	10.1 cm	11 cm
	B3	7.5cm	8.6 cm	9.3 cm	10.7 cm
	B4	5.9 cm	6.9 cm	8.8 cm	9.8 cm
	B5	6.6 cm	8.5 cm	9.0 cm	11 cm

Image 2: Growth of mushroom in the presence of **50%sludge +50%paddy straw.**

The percentage of 25% sludge and 75% paddy straw substrate were shown the growth of mushroom span in different time periods. The results were observed and tabulated in table 3 and image 3.

Table 3: Growth of mushroom in the presence of 25%sludge +75%paddy straw in days.

Table 3	Sl no.	6 Days	12 Days	18 Days	24 Days
25%sludge +75%paddy straw	C1	5.3 cm	5.3 cm	5.5 cm	5.5 cm
	C2	6.5 cm	11 cm	11.6 cm	11 .6cm
	C3	5.0 cm	6.6 cm	7.7 cm	9.2 cm
	C4	5.1 cm	6.6 cm	6.7 cm	7 cm
	C5	5.3 cm	6.1 cm	6.9 cm	8.5 cm

Image 3: Growth of mushroom in the presence of **25%sludge +75%paddy straw.**

The percentage of 0% sludge and 100% paddy straw substrate were shown the growth of mushroom span in different time periods. The results were observed and tabulated in table 3 and image 3.

Table 4: Growth of mushroom in the presence of **0% sludge +100% paddy straws in Days.**

Table 4	Sl no	6 Days	12 Days	18 Days	24 Days
0%sludge +100%paddy straw	D1	5.0 cm	5.3cm	6.4 cm	7 cm
	D2	6.5 cm	8 cm	10.4 cm	9 cm
	D3	4.9 cm	6 cm	6.4 cm	7 cm
	D4	8.2 cm	11.5 cm	12 cm	10 cm
	D5	7 cm	9.5 cm	10.2cm	8.5 cm

Image 4: Growth of mushroom in the presence of **0%sludge +100%paddy straw.**

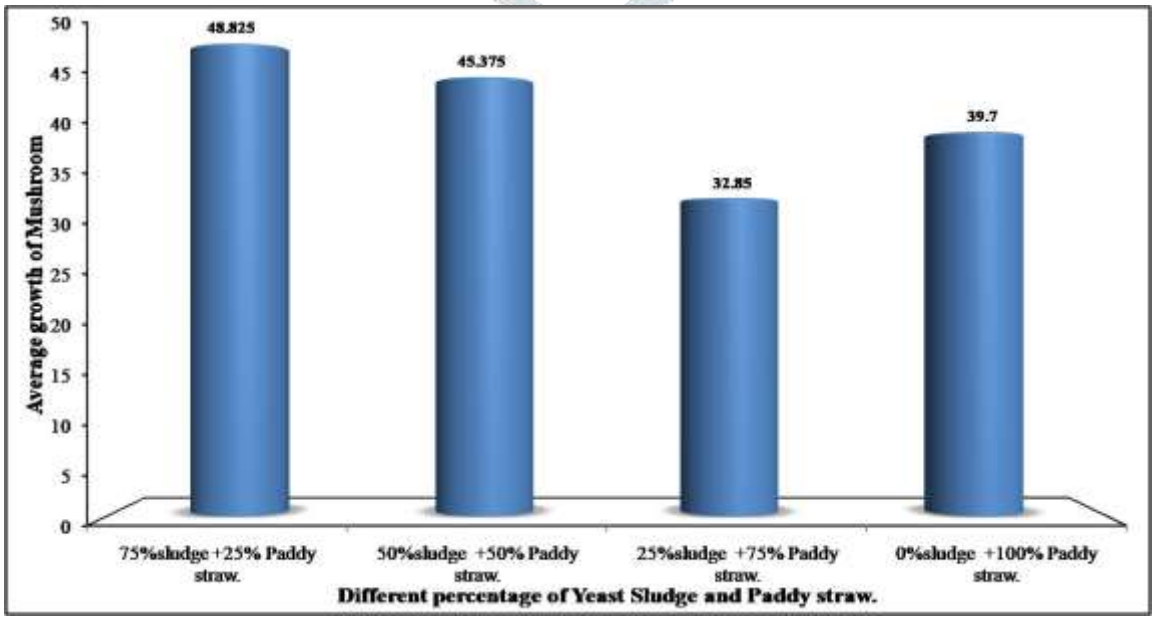

Image: 5 Average growth of Mushroom at Different percentage of Sludge with Paddy straw.

Average growth of Mushroom in a day's 6 days, 12 days, 18 days and 24 days at the Different percentage of Sludge with Paddy straw shows, among all substrates the mushroom span shown more growth around 48.82 percent average growth on 75% sludge and 25% paddy straw substrate the results were shown in image 5.

4. Conclusion:

Agro-industrial by products are rich in protein contents and various studies have described yeast sludge consists nutritional value of SCP, many factors must be considered which include nutritive value, proteins, carbohydrates, amino acids, vitamins as well other essential elements like potassium, phosphorous and it plays its role in waste management as waste materials are used as substrate. Different percentages of Sludge with Paddy straw shows, the mushroom span more growth around 48.82 percent average growths on 75% sludge and 25% paddy straw substrate. This Indicates that distillery yeast sludge acts as a good initiative like nutritive substrate like compost can be included in the growth of mushroom spawn.

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