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Nutritional value in respect of sugar, starch and ascorbic acid content of two mushroom mycelia grown on agroindustrial wastes

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Fungi are able to synthesize high amount of sugar, starch and ascorbic acid as their reserve food by utilising agroindustrial wastes (rice straw and wood dust as substrates). Both *Pleurotus ostreatus* and *Volvariella volvacea* showed promise, the former more significantly, by their nutritive values in terms of the three constituents. Nutrient content increased with time on both the carbon sources, reached maximum after 30 days of incubation and then decreased in both fungi on either of the carbon sourees.

Key words : Agroindustrial waste, carbon source, straw dust, wood dust, *Pleurotus ostreatus*, *Volvariella volvacea*, sugar, starch, ascorbic acid

INTRODUCTION

Mushrooms, now recognised universally as a food crop, are cultivated on commercial scale in many parts of the world for their dietary value as well as table delicacy. Fungi are capable of producing a wide variety of reserve food-stuff. The non-reducing disaccharide trehalose or mushroom sugar has special significance because it is synthesized by various fungi in appreciable quantities and has dietary and nutritional value for human. Mushrooms consume high amount of carbohydrates, 30-40% of which is used as mycelial body constituents while the rest is metabolised (Sengupta *et al.*, 1987).

From nutritional point of view ascorbic acid (Vitamin-C) content of the mycelia has also some beneficial role in dietary balance for animal/human. Mushrooms

are reported to possess different quantities of ascorbic acid at different stages of growth. In the present study attempts have been made to increase its content in mycelium through substrate amendment. This will evidently increase the nutritional value of the mycelium.

MATERIALS AND METHODS

Mycelia of two edible mushrooms, *Pleurotus ostreatus* (Jacq. ex. Fr.) Kummer and *Volvariella volvacea* (Bull ex. Fr.) Sing., maintained on 2% malt-agar at 27±1°C and 35±1°C respectively. Production of sugar. starch and ascorbic acid of the mycelia of *P. ostreatus* and *V. volvacea* was studied using liquid salt solution-I of Hofsten and Ryden (1975) as a basal medium containing 0.2% phosphoric acid, 0.2% ammonium sulphate and 0.02% magnesium sulphate. To the basal medium, rice straw dust (2%) and wood dust (2%) were added separately to serve as sole carbon source. The media (50 ml) were dispensed in each 250 ml Erlenmeyer flask and inoculated with mycelial disc of identical size punched out from the advancing zone of rapidly growing mycelia of the test fungi on malt-agar (2%) in Petridishes. Mycelia of the test fungi were allowed to grow on the amended salt solution-I for 15, 30 and 45 days in complete darkness at 27±1°C for *P. ostrestus* and 35±1°C for *V. volvacca*. After the incubation periods, the mycelia of the two fungi were harvested and oven dried at 50°C to constant weights.

Total sugar and starch content of the dried mycelia were estimated quantitatively following Viles and Silverman (1949) and McCready *et al.* (1950). Dried homogenized mycelial powder (1 g) was extracted with 10 ml of hot 80% ethanol at 60°C. The volume was made colourless with activated charcoal, filtered and the volume was made upto 100 ml with distilled water.

To 1 ml aliquot (diluted as and when required), 4 ml of 0.1% anthrone in concentrated H_2SO_4 (freshly prepared) was rapidly added, mixed thoroughly with a glass rod and allowed to cool. After 10 minutes, the tube was placed in a bath of ice cold. Intensity of the blue-green colonr developed was measured at 610 nm in a SICOSPEC-100 Spectrophotometer. Total carbohydrate content was expressed in terms of percentage of glucose/dry weight of mycelia.

Starch content of the mycelia was estimated following the method described below :

The residual portion after extraction with ethanol was treated with 10 ml of 70% perchloric acid in order to obtain extract of starch. Finally, the volume of the perchloric acid extracted portion was made up to 100 ml with distilled water. Total carbohydrate in the extracted solution was estimated as before and calculated by using the conversion factor of 0.9 for changing glucose values to starch.

Ascorbic acid content was estimated following Oser (1979). 100 mg of dry mycelial mat were homogenizied with 8 ml of 6% TCA (Trichloroacetic acid). After centrifugation at 5000 g for 5 minutes, the superenatant was collected and the volume made upto 100 ml. The mixture (4 ml) was mixed with 2% dinitrophenyl hydrazine in 9N H_2SO_4 (2 ml) and 1 drop of 10% thiourea solution (in 70% alcohol) and boiled for 15 minutes in a waterbath. The temperature was brought down to room temperature, 5 ml of 80% H_2SO_4 was added to it at O°C and waited for 30 minutes. The absorbance of the solution was measured at 530 nm in SICOSPEC-100 Spectrophotometer.

RESULTS

The test fungi exhibited fairly high amount of sugar in the mycelium. It was maximum after 30 days in both test organisms. Sugar content in *P. ostreatus*

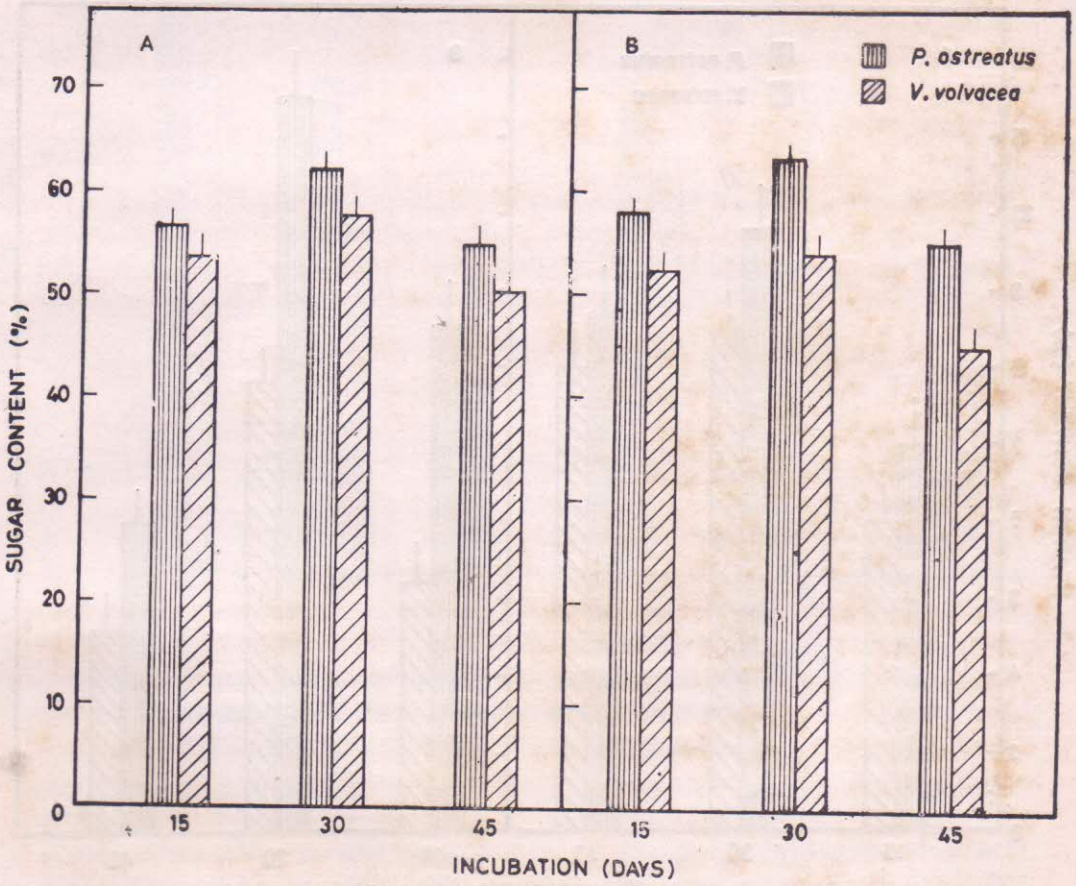

Fig. 1 : Sugar content on Salt Solution-1 after different periods
A-Rice straw dust, B-Wood dust as substrates

was higher (62 mg/100 mg mycelium) than that in *V. volvacea* (57.5 mg/100 mg mycelium) after 30 days when grown on straw dust. The same trend was evident with wood dust. In both *P. ostreatus* and *V. volvacea*, sugar content decreased subsequently on both carbon sources after 30 days. Sugar content was higher on wood dust than that in straw dust in *P. ostreatus* but it was higher on straw dust than on wood dust in *V. volvacea* (Fig. 1).

The test organisms also showed appreciable amount of starch in the mycelium. Starch content was also maximum after 30 days but decreased subsequently in both fungi on either of the carbon sources. Starch content was higher in *P. ostreotus* than in *V. volvacea* on both straw and wood dusts (Fig. 2).

Both test fungi exhibited considerable amount of ascorbic acid in the mycelium. Incubation time is a prime factor for ascorbic acid content of the test organisms.

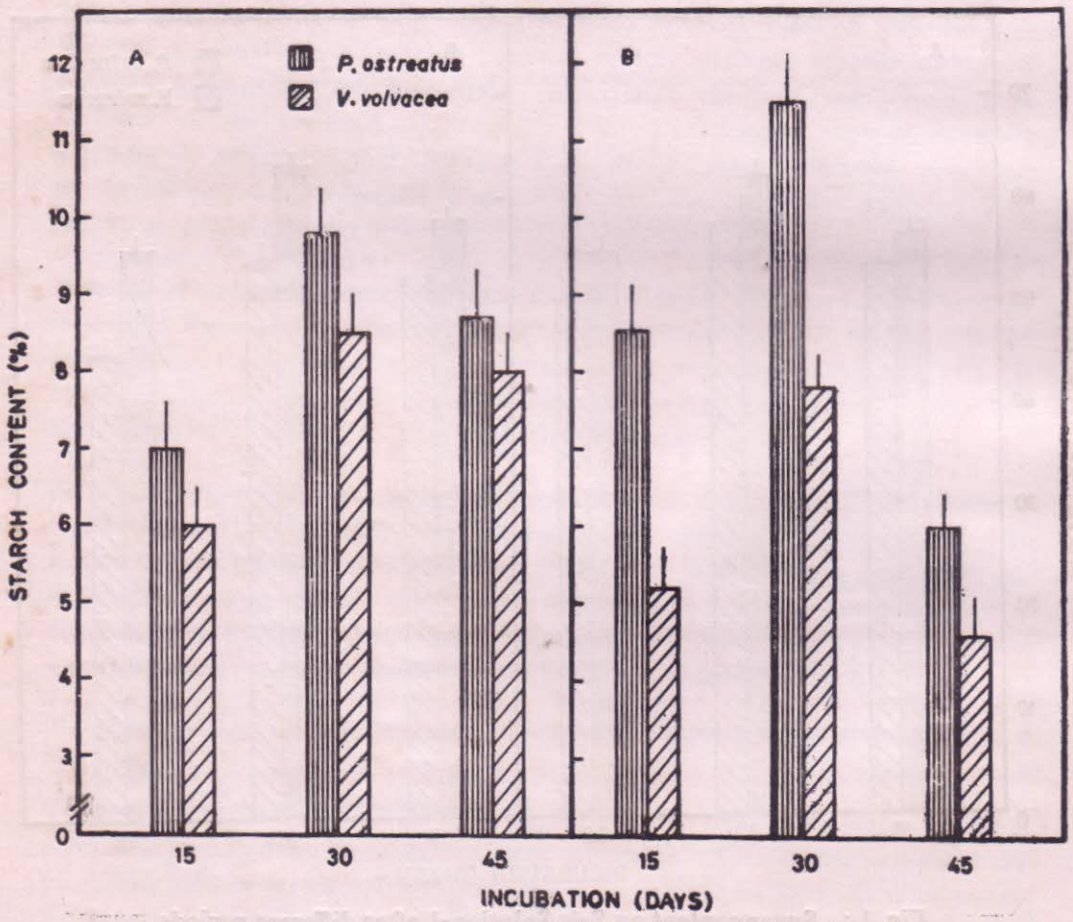

Fig.2 : Starch content on Salt Solution-1 after different periods.
A-Rice straw dust, B-Wood dust as substrates

Ascorbic acid content in *P. ostreatus* (0.64 mg) grown on straw dust was higher than that in *V. volvacea* (0.48 mg) after 15 days. The same trend was evident with wood dust. In both *P. ostreatus* and *V. volvacea*, ascorbic acid content decreased on both carbon sources after 15 days. On wood dust, mycelial ascorbic acid content was 0.30 mg and 0.24 mg in *P. ostreatus* and *V. volvacea* respectively after 30 days and further reduced to 0.16 mg and 0.12 mg after 45 days. Ascorbic acid content was higher when the fungi were grown on straw dust than on wood dust (Fig. 3).

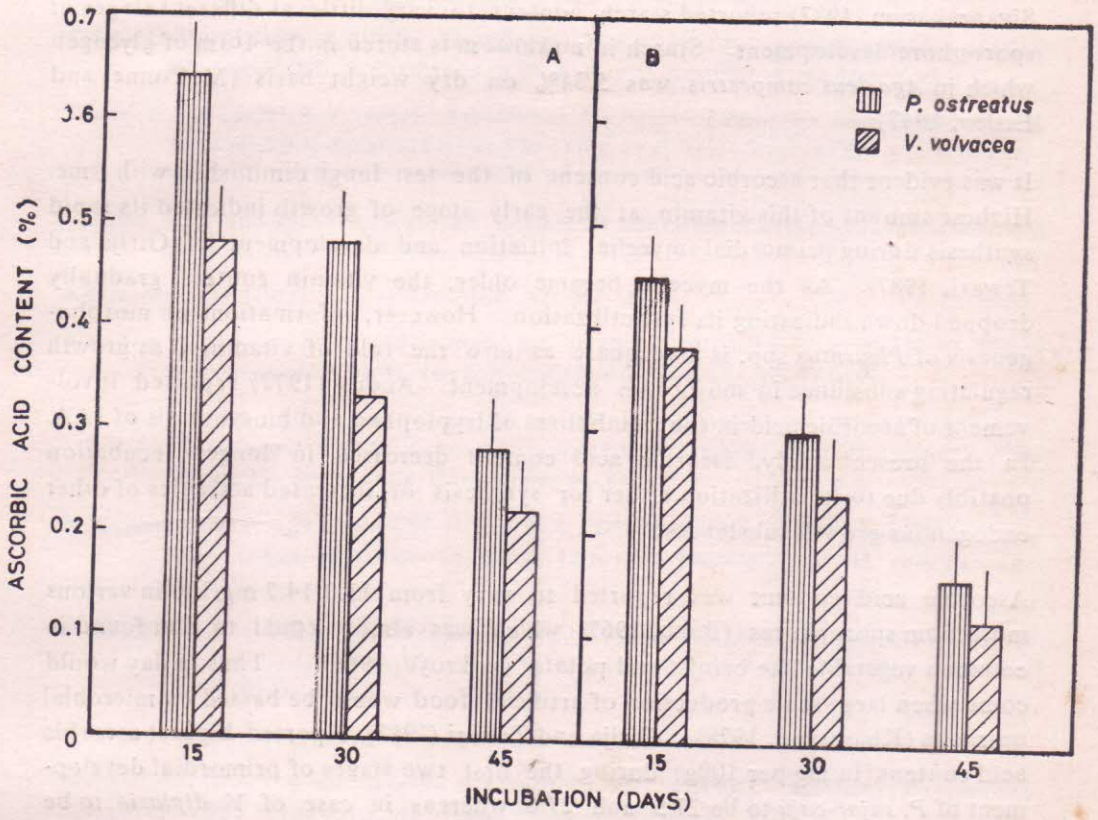

Fig. : Ascorbic Acid content on salt solution-1 After different periods
A-Rice straw dust, B-Wood dust as substrate

DISCUSSIONS

It was evident that sugar and starch content in the mycelia of the test fungi were higher in younger mycelium than in the older ones. Khurana *et al.* (1987) reported maximum (69.4) and minimum (53.64) N-free carbohydrate content in *Pleurotus fossulatus* and *Cantharellus cibarius* respectively. Crisan and Sands

(1978) while compiling analyses of over fifty species of edible mushrooms found N-free carbohydrate to vary from 20.5% to 93.4% in *Cantharellus cibarius*. *Coprinus atramentarius* and *Coprinus comatus*. Lau (1982) reported that, in general, most cultivated mushrooms contained 45-65% dry weight of carbohydrate. Sivaprakasam (1987) reported sugar content of *Pleurotus sajor-caju* to decline in mature sporophores. Bano *et al.* (1987) reported carbohydrate to be the major constituent in *Pleurotus* spp. ranging from 57.4% to 59.2%.

Starch content in the mycelia of test fungi also varied with age. However, Sivaprakasam (1987) reported starch content to vary little at different stages of sporophore development. Starch in mushroom is stored in the form of glycogen which in *Agaricus campestris* was 5.34% on dry weight basis (McConnel and Esslen, 1947).

It was evident that ascorbic acid content of the test fungi diminished with time. Highest amount of this vitamin at the early stage of growth indicated its rapid synthesis during primordial mycelial initiation and development (cf. Girija and Tewari, 1987). As the mycelia became older, the vitamin content gradually dropped down indicating its fast utilization. However, informations on morphogenesis of *Pleurotus* spp. is inadequate as also the role of vitamin-C as growth regulating substance in mushroom development. Audus (1972) reported involvement of ascorbic acid in the metabolism of tryptophan and biosynthesis of IAA. In the present study, ascorbic acid content decreased in longer incubation possibly due to its utilization either for synthesis or increased activities of other endogenous growth substances.

Ascorbic acid content was reported to vary from 13.0-14.7 mg/100 in various mushroom sporophores (Bano, 1967) which was almost equal to that found in common vegetable like brinjal and potato (Arkroyd, 1966). Thus, a day would come when large scale production of artificial food would be bassed on microbial nutrients (Kharatyan, 1978). Girija and Tewari (1987) reported highest ascorbic acid content (in mg per 100g) during the first two stages of primordial development of *P. sajor-caju* to be 27.5 and 27.6 whereas in case of *V. diplasia* to be 11.75 and 12.25. It decreased gradually to the least from 3rd to 6th stage from 19.75 to 13.28 and 11.44 to 3.705. From the nutritional point of view ascorbic acid content of basidiocarps of *P. sajor-caju* and *V. diplasia* at consumtion stage was 15.12 mg/100 g and 8.93 mg/100 g fresh weight respectively indicating that *P. sajor-caju* was a better source of ascorbic acid than *V. diplasia*. The present study revealed that mycelia of *P. ostreatus* (62 mg/100 mg) and *V. volvacea* (57.5 mg/100 mg) contained much higher amount of ascorbic acid than *P. sajor-caju* and *V. diplasia* and thus proved to possess much more nutritive value.

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