

Studies on the Nutritive Value of Mycelial Protein of some Indian Tropical Edible Mushrooms

SWAPAN K. RAY and N. SAMAJPATI

Department of Botany, Calcutta University
Calcutta 700 019

In vitro evaluation of the nutritive value of the mycelial protein of three Indian tropical edible mushrooms revealed that protein of *L. cladopus*, *L. squarrosulus* and *C. maculata* were of higher biological value in comparison with other microbial proteins. The biological value of all three fungi were found to be better when the mycelia were grown in the respective optimal media than that of the basal medium, on the basis of whole egg and FAO Reference proteins. Amino acid score was estimated considering sulphur amino acids present as limiting. So far the amino acid score was concerned, *L. cladopus* was the best followed by *C. maculata* and *L. squarrosulus*.

Key words : Nutritive value, mycelial protein, *L. cladopus*, *L. squarrosulus*, *C. maculata*

INTRODUCTION

Mushrooms have been equated to "vegetable beef steak" by some authors while others consider them to have least biological value. The nutritional contribution of mushrooms to the human diet can be evaluated from the empirical determinations of mushroom protein specifically the content of essential amino acids. According to Crisan and Sands (1978), the nutritive value of mushrooms was variable among strains and depends on the composition of the growth sub-

*Present address : Department of Botany, T. D. Bhalotia College, Asansole, Burdwan.

trates and the method of cultivation. Significant chemical compositional changes could occur with age or the particular stage of development and under various conditions of storage after harvest. Several scientists put forward their experimental observations regarding the nutritional importance of different mushrooms (Bano *et al.*, 1971); Jandaik and Kapoor, 1975; Crisan and Sands, 1978; Nag Chaudhuri and Samajpati, 1979; Kosaric and Nabuo, 1981; Gupta *et al.* 1983). Lintzel (1943) by human feeding experiment reported that the proteins of *Psalliota campestris*, *Cantharellus cibarius*, *Boletus edulis* and *Morchella esculenta* were comparable to the muscle protein in their nutritive value. The nutritional contribution of some mushrooms to human diet was comparatively evaluated with that of milk, meat and egg yolk (Fanelli, 1968). The biological value of some fungi was evaluated by chemical score, modified EAA index, non-essential and essential AA index where methionine was considered to be the limiting amino acid in all the fungal proteins. A detailed investigation on the nutritive value of proteins calculated by biological value, protein ratio, chemical score and EAA index in several edible and wild mushrooms was made by Miletic *et al.* (1983).

Wang and Li (1985) provided an analytical data of amino acid contents of 20 kinds of edible mushrooms along with their biological value.

In order to evaluate, the essential amino acid index, amino acid score, nutritional index and the biological value of the mycelial protein of *Lentinus cladopus* Lev., *Lentinus squarrosulus* Mont., and *Collybia maculata* Alb & Schw., the present study has been undertaken.

MATERIALS AND METHODS

The tissue cultures of *Lentinus cladopus*, Lev., *L. squarrosulus* Mont., and *Collybia maculata* Alb. & Schw., maintained in potato agar medium were used in the present investigation. The mycelia of the test fungi were grown in liquid basal medium (Glucose, 30 g; Peptone, 2.5 g; Yeast extract, 2.0 g; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.5 g; CaNO_3 , 0.5 g; $(\text{NH}_4)\text{HPO}_4$, 0.25 g; KH_2PO_4 , 0.25 g; FeCl_3 , 0.01 g; ZnSO_4 , 100 μg ; Inositol, 5 mg; Thiamine, 100 μg ; Biotin, 50 μg ; Folic acid, 100 μg ; CaCl_2 (O IN) 5 ml and distilled water to make the volume 1000 ml, and in the optimal media. The optimal medium for *L. cladopus* contained all the constituents of the basal medium except Glucose, Peptone, CaNO_3 and $(\text{NH}_4)_2\text{HPO}_4$ and instead of Glucose Maltose was added at the rate of 50 g/l and Yeast extract at the rate 5 g/l. The optimal media for *L. squarrosulus* and *Collybia maculata* were same as the optimal medium for *L. cladopus* except the carbon and nitrogen sources which were Sucrose (50 g/l) and Peptone (5 g/l) and Mannitol (50 g/l) and Yeast extract (5 g/l) respectively. The basal and optimal media were prepared and dispensed in the Erlenmeyer flasks (250 ml)

at the rate of 50 ml per flask. The flasks were then sterilised at 15 lbs / sq. inch pressure for 15 minutes and inoculated with 1.0 ml mycelial suspension of the test fungi separately. The inoculated flasks were then incubated for 15 days at 30°C. After the incubation period the mycelia were harvested, dried to constant weight and used for the extraction of protein.

Protein was estimated following the method of Lowry *et al.* (1951). The hydrolysis of protein, both acid hydrolysis and alkaline hydrolysis, was done following the method of Berner *et al.* (1969).

Essential Amino Acid Index was determined following the method of Oser (1951, 1959) and the empirical formula of Biological Value (Oser, 1959) is as follows :—

Biological Value = 1.09 (EAA Index) — 11.7 and was used here.

The Amino Acid Score (FAO, 1973) was determined following the formula given below.

$$\text{Amino Acid Score} = \frac{\text{mg amino acid/g test protein}}{\text{mg amino acid/g reference protein}} \times 100$$

The formula of Nutritional index (NI) of Crisan and Sands (1978) was used.

$$\text{Nutritional Index} = \frac{(\text{EAA Index} \times \text{Percentage of Protein})}{100}$$

Nutritional Index are based on both the whole egg protein and FAO reference proteins. Mentionable that *in vitro* evaluation of the nutritive value of 5 days mycelial protein was performed. So far the protein content in different physical and chemical treatments is concerned 5 days mycelia showed the maximum amount of protein, which were evaluated during physiological experiments.

RESULTS AND DISCUSSION

The results on different aspects of nutritive value of mycelial protein of the test fungi obtained are given in Tables 1 and 2.

The Essential Amino Acid Index (EAA index) of the protein has been calculated following the method of Oser (1951, 1959) based on the essential amino acid composition of the whole egg protein and FAO reference protein. The predicted Biological Value of test protein have been estimated on the basis of EAA index of both whole egg protein and that of FAO.

The Amino Acid Scores for all three test-fungi have been evaluated on the basis of Essential Amino Acids present in the whole egg protein considering only the sulphur containing amino acids as limiting. Lastly the Nutritional Index for each test fungus has also been evaluated on the basis of Biological Value and

Table 1. Data showing the Amino Acid Score and Nutritive Value of the mycelial protein (on the basis of whole Egg protein as reference) of the test-fungi grown in basal and optimal media under submerged conditions

Test Organisms	Essential Amino Acid Index (EAA)		Biological Value (BV)		Amino Acid Score*		Nutritional Index	
	Basal medium	Optimal medium	Basal medium	Optimal medium	Basal medium	Optimal medium	Basal medium	Optimal medium
<i>Lentinus cladopus</i>	62.83	66.72	56.78	61.02	33.96	43.39	14.31	26.14
<i>Lentinus squarrosulus</i>	65.71	70.53	59.92	65.17	30.18	33.96	18.87	28.18
<i>Collybia maculata</i>	46.94	48.19	39.46	40.82	32.07	35.84	11.72	17.88

*Considering S-amino acids (methionine and cystine) as limiting

Table 2. Data showing the Amino Acid Score and Nutritive Value of the mycelial protein (on the basis of FAO protein as reference) of the test-fungi grown in basal and optimal media under submerged conditions

Test Organisms	Essential Amino Acid Index (EAA)		Biological Value (BV)		Amino Acid Score*		Nutritional Index (NI)	
	Basal medium	Optimal medium	Basal medium	Optimal medium	Basal medium	Optimal medium	Basal medium	Optimal medium
<i>Lentinus cladopus</i>	92.29	97.82	88.89*	94.92	37.80	47.40	21.02	38.32
<i>Lentinus squarrosulus</i>	92.85	99.15	89.50	96.37	33.40	37.40	26.67	39.62
<i>Collybia maculata</i>	65.42	67.18	54.81	61.52	41.80	44.40	16.34	24.93

*Considering S-amino acids (methionine and cystine) as limiting

percentage of protein present in the mycelia of test fungi grown under submerged condition. All the test criteria for the determination of Biological Value of mycelial protein, a comparative study on basal and optimal media of the test-fungi have been made.

The results obtained indicate that all the test fungi have high biological value in comparison to other microbial proteins. All the mushrooms analyzed are limited in their content of at least one essential amino acid with several limited in five to seven amino acids (Crisan and Sands, 1978). Besides, maximum mushrooms are sufficient in aromatic amino acids. The findings of Crisan and Sands (1978) resemble closely the present observations. The results obtained reveal that both the species of *Lentinus* are comparatively of higher biological value. In this context, the statement of Crisan and Sands (1978) i. e. the nutritive value of mushrooms is species if not strain specific which somewhat coincides with the findings of the present case as the test fungi show the diversity in Biological value to some degree. The data also reveal that although the test fungi contain a considerable amount of mycelial protein but they show relatively lesser value of nutritional index due to the presence of less balanced amino acids.

So far the biological value and nutritional index of mycelial protein are concerned, *L. squarrosulus* comes first followed by *L. cladopus* and *C. maculata*. It is noticeable that although *C. maculata* shows a relatively lesser value of nutritional index and EAA index amongst the test fungi yet the said fungus occupies second position so far the amino acid score is concerned. This is due to the presence of sulphur containing amino acids in good amount. The reverse case is applicable to *L. squarrosulus* where the nutritional index, EAA index and biological value are higher but relatively poor in amino acid score (Tables 1 and 2).

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