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Nutritional Composition of Milky Mushroom (*Calocybe indica*) Cultivated on Paddy Straw Amended with Ragi Flour

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Abstract: Investigation of the proximate composition and mineral content (Ca, P, Mg and Fe) was carried out on milky mushroom (*Calocybe indica*) cultivated on paddy straw supplement with 5,10 and 20 per cent (on paddy straw dry weight basis) of ragi flour. control was cultivated on paddy straw alone. Results showed that the proximate composition remained largely unchanged. However, only the five per cent treatment had mineral contents that were either significantly higher (ca and P) or indifferent (Mg and Fe) from those of the control. The 10 and 20 per cent treatments had their content for phosphorus only being significantly higher than the control. Ca, Mg and Fe were significantly lower than the control in the 10 per cent treatment while mg and Fe were significantly lower in the 20 per cent treatment. It was concluded from the study that supplementation with ragi flour does not tremendously enhance the nutritional composition of milky mushroom despite the richness of the supplement material that was used. But the findings reaffirmed the findings of others that mushroom in general and milky mushroom in particular is a high protein and low fat product.

Introduction

Many research endeavors regarding mushroom cultivation on any existing or pioneering substrate dwell on the impact that these treatments have on the yield parameters of the mushroom in question and this quite understandably so. But while this trend may be relevant to agronomists and horticulturists and nutritionists, it is the impact on the nutritional composition, if any, of the resulting mushrooms that springs to mind. Studies exploring this area are hard to come be. However, Periasamy and Natarajan (2002) showed that the nutritional content of their mushrooms varied not only with species but also with different strains of the same species. It is, therefore a valid question to ask if the substrate upon which the mushroom grows may also have an impact on the nutritional composition. Indeed, El Kattan *et al*. (1991) reported an accumulation of zinc in the oyster mushrooms that they studied. In another study, El -Kattan *et al*. (1991) reported that nitrogen supplementation had increased the protein content in the oyster mushrooms. Arguments like these provide the incentive to investigate the impact that substrate has on the nutritional composition of the resulting mushrooms. The present study was therefore, under taken to investigate the impact that supplementation of paddy straw with ragi flour at different doses may have on the nutritional composition of one species of mushroom, milky mushroom (*Calocybe indica)*.

Material and Methods

In this study, paddy straw was the basic substrate and ragi flour was used as the supplement material. Dry paddy straw was chopped into pieces of 10-15 cm long and then soaked in water overnight for 16-18 hours. There after, the straw was steam pasteurized for 2 hours during which the bulk core attained a temperature of 65°C. After pasteurization, the straw was retrieved, spread on a clean floor and allowed to cool.

The ragi grains were milled into flour, apportioned into retortable polypropylene bags and then steam sterilized in an autoclave at 121°C for 20 minutes at 15 psi. Pouches in replicates of ten carried ragi flour in weights corresponding to the supplementation levels that were used in the study (five per cent , 10 per cent and 20 per cent of the dry weight of straw).

For supplementation, 2500g of wet paddy straw (800 g dry weight) was weighed off from the bulk and mixed thoroughly with the contents of one retorted pouch and the composite was then filled into polyethylene bags (12 x 18 inches and 200 gauge) and spawned layerwise (alternating layers of substrate and spawn) with sorghum grain spawn of milky mushroom obtained from the Indian Institute of Horticultural research, Hessaraghatta. Spawning was done spawning, the bag was tied, labeled and then taken for incubation in an insulated chamber maintained at 30-35°C.This process was repeated for all ten replicate bags of all the variation levels (5,10 and 20 per cent) of the ragi flour treatment.

For the control, 2500 g of wet paddy straw alone was filled into the polyethylene bags, spawned layerwise with sorghum grain spawn, the bags sealed, labeled and taken for incubation. This was also replicated ten times.

Casing with sterilized soil (121°C for 20 minutes in an autoclave) containing five per cent calcium carbonate was done for all bags upon full colonization of the entire visible surface of the substrate by mushroom mycelia. After casing the bags were returned to the incubation chamber for cropping to obtain initiation and maturation of mushroom fruit bodies.

Once the fruiting bodies were mature, samples of these from each bag of each variation level of the treatments were pooled separately as control, 5 per cent, 10 per cent and 20 per cent treatments and prepared for analysis of nutritional composition. Nutrients that were analyzed included crude protein, crude fat, crude fiber and ash. Carbohydrat and energy were computed using standard formulae. Components of the ash that were analyzed were calcium, phosphorus, magnesium and iron. Standard methods were used for the analyses and triplicate values were ensured for each parameter analyzed.

Results and Discussion

The results presented tables 1 and 2 show the comparison of nutrient cmpositions of milkymushrooms from the different ragi supplementation treatments with the control sample, which was cultivated on paddy straw only. Because there are very few studies on the nutritional composition of milky mushrooms and even less on the nutrient composition of milky mushroom as influenced by the substrate, it is difficult to give a reasonable argument for the results obtained from the ragi flour supplementation and its impact on the nutrient composition of milky mushrooms.

Most of the differences observed between milky mushrooms from the ragi flour treatments and the mushroom cultivated on paddy straw alone (control) were seed in the micronutrient compositions. However, the five per cent ragi treatment sample had significantly lower protein content than the control. This could be attributed to the possible inclusion of a higher proportion of the stipe material in the sample used for analysis. Stipe material was found to have a higher proportion of fiber (El Kattan *et al*., 1991) and a lower proportion of protein (El Kattan *et al*., 1991; Devi and Devi, 1992) . On the other hand, the 20 per cent ragi treatment sample had highest fat content that was significant over that of the control and other treatments (6.48 per cent on dry weight basis) but this value was still comparable to the values reported for oyster mushroom (El Kattan *et al*., 1991) at 5.79 - 7.70 per cent on dry weight basis but mush higher than value reported by Ekanem and Ubengama (2002) at 1.5 per cent on dry weight basis.

All other macronutrient contents and energy for mushrooms from the ragi flour treatments were not significantly different from the mushroom of the control substrate. However, carbohydrate was still the major component for mushrooms from all the treatments and the control and it ranged between 64.41 per cent and 71.67 per cent on dry weight basis. This level of carbohydrate content is higher than that of the oyster mushroom reported by El Kattan *et al.* (1991) which ranges between 52.2 per cent and 56.6 per cent. The ash content of mushrooms from the substrate amended with 20 per cent ragi flour (Table 1) was found to be high at 1.12 per cent, although this was not significantly different from the control. It is possible however, that this increased content was due to the high content of phosphorus at 163.35 mg per cent (Table 2) in mushrooms from this treatment.

The micronutrient conents exhibited more variations relative to the control compared to the macronutrients. For calcium, the 5 per cent and 10 per cent treatments showed a signficant positive and negative difference, respectively, from the value in the control sample. Only the five per cent sample was consistent with the expectations for the calcium content of the mushrooms after ragi supplementation. The 10 per cent sample showed a significantly lower content while teh 20 per cent sample remained virtually unchanged. In short, the relatively high calcium content in ragi flour was not well absorbed and retained at supplementation levels higher than five per cent. It is worth noting, however, that even the significantly increased level of calcium in the five per cent treatment relative to the control was not high enough to make the milky mushroom a good source for this nutrient to meet the high recommended daily intake of 400-1000 mg (Gopalan *et al.,2002).*

The five per cent treatment also showed a signficant impact on the nutrient composition of its mushrooms for iron and magnesium when compared to the contents of the mushrooms from the 10 per cent and 20 per cent ragi flour supplementation level for these minerals. While its content for iron and magnesium was not significantly higher than that of the control, it still maintained its contents at values not significantly different from the control. It was however, found to have the lowest content for phosphorus compared to mushrooms from the other ragi supplementation treatments although its content for this mineral was still significantly higher than that of the control.

Table 1. Macronutrient compostition (g % on fesh weight basis) of milky mushroom cultivated on paddy straw alone (control) and paddy straw amended with ragi flour

Treatmetns	Moisture	Protein	Fat	Carbohydrate	Energy (kcal %)	Ash	Fiber
Control	88.90	1.84	0.28	7.66	40.52	0.93	0.39
5%	89.27	1.40*	0.37	7.69	39.69	0.90	0.37
10%	89.00	1.64	0.34	7.69	40.38	0.94	0.39
20%	89.24	1.64	0.69*	6.93	40.49	1.12	0.38
CD (5%)	1.23	0.20	0.19	1.33	5.19	0.02	0.02

* Signficantly different from control value at 5% level

All values are means of three replications

Phosphorus appears to have been well absorbed from the supplement because its content in the mushrooms increased with the level of supplementation, the 20 per cent treatment having the highest content at 163.35 mg / 100g on fresh weight basis. El Kattan *et al.* (1991) found that phosphate (just like potassium) were present in good quantities in the sporophores of oyster mushroom ad they attributed this to the possibility that these minerals were probably necessary for growth and they resulted in increased yield when used as mineral supplements. Manning (1985) stated that the high content of phosphorus in mushrooms (75 mg per cent) was able to meet a signficant portion of the recommended daily intake for phosphorus. The values obtained in the present study are certainly close enough to support that statement. This reaffirms mushrooms as good sources of phosphorus in the diet. Overall, the five percent supplementation level emerged as the superior level of supplemetaion since its content for all the minerals analyzed was consistently higher and / or on par with that the control sample. The other supplementation levels (10 per cent and 20 per cent) did not exhibit the same level of consistency.

Table 2. Mineral composition (mg % on fresh weight basis) of milky mushroom cultivated on paddy straw alone (control and paddy straw amended with ragi flour

Treatments	Calcium	Magnesium	Iron	Phosphorus
Control	5.61	2.22	1.86	67.99
5%	8.56*	2.14	1.87	84.93*
10%	4.40*	1.10*	1.46*	98.55*
20%	5.40	1.08*	0.59*	163.35*
CD (5%)	0.21	0.25	0.09	2.20

* Signficantly differnet from control value at 5%

All values are means of three replications

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