Biological evaluation of chemically preserved Agaricus bitorquils mushroom

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ABSTRACT

Citric acid (0.1%), acetic acid (0.3%), sodium chloride (5%), potassium metabisulfite (0.05-0.09%), ascorbic acid (0.1%) and sodium benzoate (0.05 0.09%) and potassium sorbate (0.1%) were used for the extension of shelf life of mushrooms. Biological evaluation was done to check the efficacy of mushroom protein after 90 days of preservation. Protein efficiency ratio (PER), net protein utilization (NPU), feed efficacy (FE), biological value (BV), net protein ratio (NPR) and protein digestibility (PD) were determined. The data was analyzed statistically and the results were interpreted.

Keywords: Mushroom, preservation, acetic acid, citric acid, protein, biological value.

INTRODUCTION

Mushrooms are highly perishable and deteriorate within short period of time after harvest. These mushrooms require great deal of attention during storage, marketing and processing at the post-harvest stages as some of the problems encountered are discoloration, weight loss, flavor loss, shrivelling and browning (Doore & et al. 1987).

From the quality point of view mushrooms have to be processed immediately after harvesting. Different doses of sodium benzoate (SB) and potassium meta bisulphite (KMS) were used to increase the shelf life of mushrooms. Mushrooms preserved in this manner are very economical and can be transported to far off distant places conveniently, to be used for further processing and preservation (Sandhu and Aggarwal 2001).

No doubt the mushrooms are good source of protein but method of food preservation poses a potential problem in digestion of protein. All the amount of protein which is taken is not digested. In addition to the preservation, the present research was designed to study efficacy of chemically preserved mushrooms. The absorption and bioavailability of protein using Albino male rats was also estimated.

MATERIALS AND METHODS

Following two groups of chemicals were used for preservation,

Fixed Chemicals

a) Citric acid 2-4% for adjusting the pH to 4 - 4.5
b) Ascorbic acid 0.1% as an antioxidant.
c) Acetic acid 0.3% as preservative.
d) Sodium chloride 5% as preservative
e) Potassium sorbate 0.1% as preservative.

Variable chemicals

To find out minimum effective dose of combined effect of chemical preservatives, the lower permissible limit of KMS and SB 0.1 % was further subdivided into nine variable combinations randomly as shown in Table-1.

Table-1. Doses of chemical treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>KMS %</th>
<th>SB%</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>T2</td>
<td>0.08</td>
<td>0.06</td>
</tr>
<tr>
<td>T3</td>
<td>0.06</td>
<td>0.08</td>
</tr>
<tr>
<td>T4</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>T5</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>T6</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>T7</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>T8</td>
<td>0.09</td>
<td>0.07</td>
</tr>
<tr>
<td>T9</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>T10 (Fresh)</td>
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</tr>
</tbody>
</table>

SB = Sodium benzoate
KMS = Potassium meta bisulphite

Preparation of mushroom powder

The mushrooms were blanched for four minutes in water to inactivate enzymes and filled in glass jars along with chemicals. The jars were made air tight at about 90 °C. The lids were internally lined with aluminum foil to prevent any leakage or corrosion. After 90 days storage period, the mushrooms were taken out of the steeping solution and dried in an air oven at 105 °C till a constant weight was obtained. The dried mushroom powder was used for preparation of diet.
BIOLOGICAL EVALUATION

The albino rats were purchased from National Institute of Health (Veterinary Division) Islamabad, and brought to fruit and vegetable laboratory at the Institute of Food Science and Technology, University of Agriculture Faisalabad.

The diet of the rats was prepared by mixing preserved mushroom powder to study the protein efficacy, along with an inert carrier like maize starch as reported by Warner (1962).

Mushroom diet was fed to rats for 10 days. Biological study was conducted by the method of Miller and Bender (1955). Weaning was done at 30 days of age. The rats were put on the stock diet for seven days prior to the experiment. Clean water was made available during whole study period. Body weight of rats was recorded on daily basis. The fecal material of each cage was collected daily and dried to a constant weight for nitrogen determination. At the end of the trial all the rats were killed with over dose of chloroform and their skull and abdominal cavities were opened. The carcasses of each group including the intestinal contents were weighed before and after drying at 105°C to a constant weight. The dried carcasses were ground in the domestic mincer and were stored in airtight bottles till the estimation of body nitrogen. The nitrogen contents of each diet, faeces and carcasses were determined by Kjeldhal's method.

RESULTS

Feed Efficiency

Net Protein Utilization

Net protein utilization of the Agaricus bitorquis varied from 42.10 (T₂) to 74.41 (T₁). The differences among the means were highly significant (P<0.01). Treatment T₁ had significantly higher net protein utilization.

Biological Value

Biological value of Agaricus bitorquis varied from 0.44 (T₃) to 0.76 (T₁). The differences among the means were highly significant. Treatment T₁ had significantly higher biological value.

Net Protein Ratio

Net protein ratio of the Agaricus bitorquis varied from 1.67 (T₆) to 2.63 (T₁). The differences among the means were highly significant. Net protein ratio for treatment T₂ and T₃ and T₅ and T₆ were observed to be similar as is evident from Table 3.

Protein Efficiency Ratio

Protein efficiency ratio of the Agaricus bitorquis varied from 0.95 (T₃) to 1.85 (T₁). The differences among the means were highly significant. Treatment T₁ had significantly higher protein efficiency ratio than all other treatments.

DISCUSSION

Digestibility varies in test animals considerably (Moughan and Donkoh, 1991). Digestibility of treatment T₁ was higher than all other treatments. The results of digestibility in the present study are in agreement with the previous findings of Sarwar et al. (1989). The digestibility was found to be higher than the findings of Thayumanavan and Manicham (1980). They showed digestibility as 84.1 in P. sajor-caju. Flegg and Maw (1976) concluded that digestibility of P. floridea (79.07) has been found to be higher than that of spinach protein (73%) but poorer than that of meat (99%). In the present study, it was found that digestibility was significantly affected by chemical preservation. Duncan's multiple range test was applied to differences of means.
The result showed that digestibility of diet containing treatment T₇ was significantly different from other groups.

Net protein utilization values of different experimental diets are given in Table 3. Net protein utilization is in agreement to the findings of Thayumanavan and Manicham (1980) 75.1 %, and in this study it varied from 42.10 (T₃) to 74.41 (T₁), these variations may be due to the deleterious effects of chemicals on protein. Net protein utilization of the fresh mushroom (73.76) and that of T₇ (74.41) are similar. Analysis of variance showed a highly significant difference between different groups of experimental diet, as presented in Table-2.

Duncan’s multiple range test revealed that net protein utilization of diet containing treatment T₁ (0.08 % KMS and 0.08% Sodium benzoate) and fresh mushroom (96.28%) were significantly different from other groups.

Biological values calculated from net protein utilization and digestibility is shown in the Table-3. Biological values of T₂ and T₃ were similar (0.76 and 0.74 respectively). Biological values observed in this study were similar to those observed by Thayumanavan and Manicham (1980) and Udipi and Punekar (1980). This difference may be due to chemicals used, substrate used for cultivation, environment and damaging effect of heat on amino acids during the baking of the starch containing the mushroom powder.

Duncan’s multiple range test showed that the difference in biological values of diet containing treatment T₁ (0.08 % KMS and 0.08% Sodium benzoate) and fresh mushroom was non-significant but differed significantly from other groups. A non-significant difference was observed in diets containing T₂ (0.08 % KMS and 0.06% sodium benzoate) and T₃ (0.06% KMS and 0.08% sodium benzoate).

Net protein ratio of the diet containing treatment T₁ was higher than the other diets. Statistical analysis showed highly significant differences among various treatments. Animals on diet containing 0.08 % KMS and sodium benzoate differed significantly from other treatments. However, a non-significant difference was noticed between diets containing treatments T₂, T₃ and T₄. T₇. It was observed that net protein ratio of diet containing treatment T₁ and fresh mushroom powder is same.

Protein efficiency ratio of the Agaricus bitorquis varied from 0.95 (T₄) to 1.85 (T₁). The analysis of variance (Table-2) indicated highly significant differences among the means for PER values of various experimental diets. Duncan’s multiple range test showed that PER values of diet containing treatment T₁ (0.08 % KMS and 0.08 % sodium benzoate) differ significantly from other groups. A non-significant difference was observed in diets containing T₂ (0.08 % KMS and 0.06% sodium benzoate), T₃ (0.06% KMS and 0.08% sodium benzoate) and fresh. The results of the present study are in agreement to the findings of Gupta et al. (1981).

Feed efficiency of the diet containing treatment T₇ (0.82) was highest and lowest for diet containing treatment T₁ (0.45). It shows that rats consumed significantly the lowest feed per unit weight gain on diet containing treatment T₁ (0.08 % KMS and Sodium benzoate).

**CONCLUSIONS**

On the basis of these findings, it is concluded that diet containing 0.08% KMS and 0.08% sodium benzoate (T1) showed best results, and protein was less damaged due to inhibition of enzyme activity. The mushroom, thus, preserved has better nutritive status that may be used to make up the protein deficiency of
the people. These mushrooms are likely to be less expensive than those preserved by other techniques like canning and refrigeration.

REFERENCES


