Development and quality evaluation of mushroom Gravy

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Abstract
Mushrooms are credible source of nutrients including considerable amounts of protein, dietary fibre, minerals, and vitamins. Aim of this study is to evaluate the nutritional quality and sensory quality of prepared mushroom gravy. The selected TNAU mushroom varieties are (Ooty-1 button mushroom, CO-1 oyster mushroom, APK-2 milky mushroom) which are commercially available in Madurai. CO-1 oyster mushroom contains (92.1 %) of moisture, antioxidants activity (276 mg/100g), ascorbic acid (3.62 mg/100g), iron (4.3 mg/100g) and calcium (11 mg/100g). Ooty-1 button mushroom had high protein, phosphorus (3.3 g/100g, 86 mg/100g) and APK-2 milky mushroom contained high amount of fibre and ash. In the developed mushroom gravy the addition of ingredients increased the nutritional quality of the product. Among the three TNAU mushroom varieties CO-1 oyster mushroom was highly suitable for the preparation of mushroom gravy.

Keywords: antioxidants activity, mushroom varieties, physicochemical, sensory quality

Introduction
Edible mushrooms are the fleshy and edible fruit bodies of several species of fungi. Mushrooms belong to the macro fungi, because their fruiting structures are large enough to be seen with the naked eye. They can appear either below ground (hypogeous) or above ground (epigeous) where they may be picked by hand. Edibility may be defined by criteria that include absence of poisonous effects on humans and desirable taste and aroma [19]. Wild mushrooms are becoming more and more important in our diet for their nutritional [17] and pharmacological characteristics. The high protein and low fat/energy contents of wild edible mushrooms, reported by many workers including our research group, make them excellent foods for use in low caloric diets. Concerning the pharmacological potential such as antimicrobial [4]. Mushrooms have also become attractive as a functional food, antiviral, antitumor, antiallergic, immunomodulating, anti-inflammatory, antiatherogenic, hypoglycemic, and hepatoprotective properties, and as a source for the development of drugs and nutraceuticals. Among them, phenolic compounds exhibit potent antioxidant activities [28]. Antioxidants can scavenge free radicals and increase shelf life by retarding the process of lipid peroxidation (LPO), and the consumption of antioxidant-rich foods could bring diverse physiological benefits to the consumer, such as protection against human diseases associated with oxidative stress, like coronary heart disease and cancer [5]. Mushrooms are recognized worldwide as medicinal foods rich in nutrition by doctors. The Food and Drug Administration (FDA) has officially designated mushroom as "Healthy foods" [3]. Nutrient content of fresh mushroom were as follows: moisture 88.15-91.64%, protein 4.22-5.89 %, crude protein 18.46-27.78 %, carbohydrate 4.54-4.68 %, fat 1.49-1.90, ash 1.6-2%, energy value 310-352.32 kcal/100g [12]. The objective of this study was development and quality evaluation of mushroom gravy from TNAU three mushroom varieties (Ooty-1button mushroom, CO-1 oyster mushroom, APK-2 milky mushroom).

Materials and Methods
Three TNAU mushroom varieties were purchased from three different mushroom farms in Madurai (figure 1). Raw ingredients were purchased from local departmental stores for preparation of mushroom gravies.
Preparation of mushroom gravy
Mushroom, onion, tomato, ginger garlic paste, cinnamon, cumin powder, coriander powder, anise powder, turmeric powder, chilli powder, pepper, oil salt ingredients were used to prepare the mushroom gravy (figure 2).

Chemical composition
The general compositions of mushrooms and mushrooms gravies were determined using standard methods. Moisture contents of the sample were determined by the AOAC (1995) [1], pH by Hart and Fisher (1971) [13]. Protein were determined using a Kjeldahl digestion system (Ma and Zuazaga, 1942) [16]. Crude fiber content by Maynard (1970) [20]. Fat contents were determined by extraction with petroleum ether for 2h using a Soxhlet apparatus Cohen (1917) [8]. Total Antioxidant activity was determined as per the method described by Goupy et al., (1999) [11]. Ash by Hart and Fisher (1971) [13]. The titratable acidity, calcium and phosphorus contents was analysed by the method described by Ranganna (1995) [22]. The iron content of the sample was estimated by the method described by wong (1928) [27].

Results and Discussion
Chemical composition and nutrient content of fresh mushroom varieties
The chemical characteristics viz., moisture, pH, acidity, protein, fat, crude fiber, ash, calcium, phosphorus, iron, ascorbic acid and total antioxidant activity of fresh TNAU mushroom varieties were analyzed and the data are presented in table 14.

Sensory evaluation
The prepared samples were analysed for organoleptic evaluation by 15 semi trained panelists using 9-point hedonic scale as appearance, colour, flavour, texture, taste and overall acceptability [21].

Statistical analysis
Data from all experiments were performed in triplicate for each sample. The results of the three replicates were pooled and expressed as mean ± standard deviation. Data were analyzed using Data Entry Module for AGRES Statistical Software (Version 3.01). Analysis of variance (ANOVA) was used to compare fresh and TNAU mushroom gravies by using Factorial Completely Randomized Design (FCRD) method as described by Gomez and Gomez (1984) [10].
Gupta et al., (2004) [12] fat content of fresh mushroom was ranged from 1.49 to 1.90 g/100g. Fresh oyster mushroom had 0.33 g/100g of fat [14]. Similar results were obtained in the present study i.e. V3 mushroom contain low amount of fat compared to other varieties.

The variety V3 had the highest crude fiber and ash (1.67 g/100g and 0.75%) when compared to V1 (1.56 g/100g and 0.69%) and V2 (1.23 g/100g and 0.67%). Cheung in (1998) [7] reported that the fresh mushrooms contain a relatively high amount of fibre which may be responsible for its relatively high amount of ash. Similar results was obtained in the present study, as the fibre content was higher in V3 variety, its ash content was also higher among all the varieties.

Haytowitz, (2006) [12] studied that the fresh oyster mushroom had 0.77 % of ash and 2.10 g of dietary fiber/100g. The ascorbic acid and total antioxidant activity was higher in the V3 variety which was recorded as (3.62 and 276 mg/100g) followed by V1 (3.01and 246 mg/100g), V3 (2.91 and 212 mg/100g). Similarly Furlani et al., (2008) [9] reported that the ascorbic value of fresh mushroom was 6.67 mg/100 g.

The variety V2 had the highest iron and calcium (4.3 mg/100g and 11 mg/100g) when compared to V1 (1.6 and 6.2 mg/100g) and V3 (1.71 mg/100g and 5.9 mg/100g). Buwjoom et al., (2004) [6] indicated that calcium level in fresh mushroom to be varied from 0.46 to 0.47%.

The highest phosphorus content was recorded in V1 variety (88 mg/100g) followed by V3 and V2 varieties (67.9 and 18mg/100g) respectively. Furlani et al., (2008) [9] study shows that the phosphorus values on a wet weight basis were 104.13 mg/100 g which was similar to the present study.

Statistical analysis
Statistical analysis revealed that the acidity, protein, fat, crude fiber, calcium, iron, phosphorus, ascorbic acid and total antioxidant activity were highly significant at P≤0.05 among varieties. No significant change was observed in moisture, pH, ash at P≥0.05.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Variety</th>
<th>Chemical parameters</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>V1</td>
<td>91.1±1.1003</td>
<td>92.1±1.6012</td>
</tr>
<tr>
<td>pH</td>
<td>V1</td>
<td>6.81±0.207</td>
<td>7.03±0.297</td>
</tr>
<tr>
<td>Acidity</td>
<td>V1</td>
<td>0.04±0.011</td>
<td>0.03±0.0083</td>
</tr>
<tr>
<td>Protein (g/100g)</td>
<td>V1</td>
<td>3.34±0.112</td>
<td>2.60±0.112</td>
</tr>
<tr>
<td>Antioxidant activity</td>
<td>V1</td>
<td>246±2.062</td>
<td>276±4.726</td>
</tr>
<tr>
<td>Fibre (g/100g)</td>
<td>V1</td>
<td>1.56±0.004</td>
<td>1.43±0.029</td>
</tr>
<tr>
<td>Fat (g/100g)</td>
<td>V1</td>
<td>0.73±0.008</td>
<td>0.51±0.002</td>
</tr>
<tr>
<td>Ascorbic acid (mg/100g)</td>
<td>V1</td>
<td>3.01±0.022</td>
<td>3.62±0.061</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>V1</td>
<td>0.69±0.015</td>
<td>0.65±0.0128</td>
</tr>
<tr>
<td>Iron (mg/100g)</td>
<td>V1</td>
<td>1.6±0.007</td>
<td>4.3±0.011</td>
</tr>
<tr>
<td>Calcium (mg/100g)</td>
<td>V1</td>
<td>6.2±0.122</td>
<td>11±0.475</td>
</tr>
<tr>
<td>phosphorus (mg/100g)</td>
<td>V1</td>
<td>88±3.323</td>
<td>18±0.243</td>
</tr>
</tbody>
</table>

Data indicate analyses of triplicates mean ± standard deviation
Table 2: Nutrient content of TNAU mushroom gravy

<table>
<thead>
<tr>
<th>S. No</th>
<th>Chemical parameters</th>
<th>( V_{2}T_{1} )</th>
<th>( V_{3}T_{1} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Moisture (%)</td>
<td>82±0.340</td>
<td>83.4±0.375</td>
</tr>
<tr>
<td>2</td>
<td>pH</td>
<td>5.75±0.096</td>
<td>5.8±0.213</td>
</tr>
<tr>
<td>3</td>
<td>Acidity (%)</td>
<td>0.12±0.005</td>
<td>0.08±0.002</td>
</tr>
<tr>
<td>4</td>
<td>Protein (g/100g)</td>
<td>7.3±0.177</td>
<td>6.69±0.030</td>
</tr>
<tr>
<td>5</td>
<td>Antioxidant activity (mg AAEAA /100g)</td>
<td>2123±48.221</td>
<td>2132±46.124</td>
</tr>
<tr>
<td>6</td>
<td>CrudeFibre (g/100g)</td>
<td>5.67±0.236</td>
<td>5.74±0.093</td>
</tr>
<tr>
<td>7</td>
<td>Fat (g/100g)</td>
<td>4.63±0.168</td>
<td>4.41±0.051</td>
</tr>
<tr>
<td>8</td>
<td>Ash (%)</td>
<td>2.32±0.100</td>
<td>2.36±0.055</td>
</tr>
<tr>
<td>9</td>
<td>Iron(mg/100g)</td>
<td>10.9±0.048</td>
<td>13.8±0.422</td>
</tr>
<tr>
<td>10</td>
<td>Calcium(mg/100g)</td>
<td>207.9±7.102</td>
<td>213.8±4.047</td>
</tr>
<tr>
<td>11</td>
<td>Phosphorus(mg/100g)</td>
<td>231.4±5.527</td>
<td>161±6.675</td>
</tr>
</tbody>
</table>

Data indicate analyses of triplicates mean± standard deviation

\( V_{1}T_{j} - Ooty-1 Button mushroom gravy \)

\( V_{2}T_{i} - CO-1 Oyster mushroom gravy \)

\( V_{3}T_{i} - APK-2 Milky mushroom gravy \)

The total antioxidant activity was higher in the \( V_{2}T_{1} \) variety which was recorded in 2132±46.124 mg/100g respectively followed by \( V_{1}T_{1} \) (2123±48.221mg/100g) \( V_{3}T_{1} \) (2019±70.97mg/100g).

Antioxidant potential (% DPPH inhibition) increased with increasing levels of mushroom powder in noodles [2].

**Statistical analysis**

Statistical analysis showed that the acidity, protein, fat, crude fibre, calcium, iron, phosphorus were highly significant at P≤0.05 among mushroom gravies. Whereas the pH, ash content and antioxidant activity among mushroom gravies were no significantly different at P≥0.05.

**Sensory analysis**

The Sensory quality of analysis of mushroom gravy using a 9-point hedonic scale score revealed that CO-1 oyster mushroom gravy had overall acceptability with the highest score point of 8.7 followed by Ooty-1 button mushroom gravy 8.6 and APK-2 milky mushroom gravy the lowest score point of 8.4 (Figure 3).

**Fig 3**

**Conclusion**

Mushrooms are protein rich and low fat food. Mushroom gravy is meat-free alternative for vegetarian offers positive health benefits. CO-1 oyster mushroom gravy had highest amount vitamin C, antioxidants and minerals (calcium, iron) content and mushroom gravy made with CO-1 oyster mushroom had high overall acceptability then others.

**Acknowledgement**

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**References**

7. Cohen EH, Association of official analytical chemists.1917; 54: