Caglarlmak, Necla; Unal, Kemal; Otles, Semih
Determination of nutritive changes of canned mushrooms (Agaricus bisporus) during storage period
Colegio de Postgraduados
Puebla, México

Available in: http://www.redalyc.org/articulo.oa?id=68513203
DETERMINATION OF NUTRITIVE CHANGES OF CANNED MUSHROOMS (Agaricus bisporus) DURING STORAGE PERIOD

Necla Çaglar İrmak¹, Kemal Ünal² and Semih Ötles²

¹ Gazi Osmanpasa University, Agricultural Faculty, Food Engineering Dept. Taslıcılfik campus 60240-Tokat, Turkey. E-mail: neclac@tokat.gop.edu.tr
² Ege University, Engineering Faculty, Food Engineering Department, 35101, Bornova-Izmir-Turkey.

Accepted for publication May 31, 2001

ABSTRACT

Mushrooms (A. bisporus) have a high nutritive value. Consuming fresh mushrooms is not productive because of enzyme activity and other limiting factors. The canning process is one food treatment that provides long product shelf-life. The changes of nutrients were determined by proximate composition: fat, protein, moisture, ash, and total carbohydrates. Minerals: Zn, Cu, K, Na, Ca, Cr, and P. Water soluble vitamins: B₁ (thiamine), B₂ (riboflavin), folic acid, pantothenic acid, niacin and vitamin C (L-ascorbic acid). These nutrients were determined on both fresh mushrooms and during storage for six months. The analyses were made at one and one-half month intervals. Mushrooms were exposed to blanching in the canning process and were sterilized. During blanching and storage, usually the nutritive contents changed. Values of freshly canned and stored products (the first value in parenthesis belongs to the fresh product, the second value represents the end of the six month storage period) were (%): fat (0.35-0.30), protein (3.43-2.24), moisture (91.73-92.02), ash (0.71-1.60), total carbohydrate (3.78-3.84). Minerals (ppm): Zn (5.47-1.70), Cu (1.59-3.79), K (2445.50-140.40), Na (171.59-6596.13), Fe (8.73-9.20), Ca (39.60-68.06), Cr (trace-trace), P (882.30-446.40). Vitamins (mg/100g): B₁ (thiamine) (0.094-0.028), B₂ (riboflavin) (0.396-0.176), folic acid (0.078-0.020), vitamin C (ascorbic acid) (5.72-2.31), pantothenic acid (2.29-1.22), niacin (5.35-4.29).

Key words: Blanching, canning, Agaricus bisporus, nutrients, proximate, vitamins, minerals.
INTRODUCTION

*Agaricus bisporus* (Lge.) Imb., the commercial mushroom species, is commonly known all over the world. It is preferred in the canning industry, because of its white colour. Cultivated mushrooms have high protein content, water soluble vitamins and minerals when compared to other foods. The most delicious mushrooms are *Boletus edulis*, *Clitopilus prunus*, *Macrolepiota procera*, *Cantharellus cibarius*, and *Tricholoma matsutake*, according to Wu.

The protein of other cultivated mushrooms, including "oyster mushroom," *Pleurotus ostreatus*; "paddy straw mushroom," *Volvariella volvacea*; "shitake mushroom," *Lentinula edodes*; as well as that of *Agaricus bisporus*, have been shown to compare favorably with cows' milk. *A. bisporus* and *Pleurotus* sp. were examined in another study and found rich in essential amino acids. However, mushrooms are not only used for food; *Ganoderma* spp. has been used empirically in China, Korea, and other countries, for stimulating the immune system, or bioregulatory effects, and reducing side effects of chemotherapy.

The proximate composition, and chemical compounds, minerals and vitamins of *A. bisporus* have been examined by others. The hemagglutinins and thiaminase may not be the only things found in mushrooms that can reduce their nutritional value and all species or even varieties may contain them. Cooking can destroy anti-nutritional factors that consist of proteins. Vitamin analyses have shown mushrooms to be very similar to yeast, except that thiamine is found to be low in mushrooms. Thiamine is required for decarboxylation, a reaction required by all living tissues.

One of the most common treatments of mushrooms is the canning process. During sterilization some of the nutritive contents change quantitatively. Factors such as the blanching period, method of boiling, composition of the boiling water, and pH have effects on the nutritive contents.

Blanching treatment is one of the most important steps of food processes like canning, freezing and dehydration. Its affect was established upon vitamin C and B complex vitamins. Ötes et al. determined losses of vitamins due to blanching and found, vitamin C, 39.52%; vitamin B1, 44.69%; vitamin B2 (riboflavin), 28.80%; folic acid, 50.00%; pantothenic acid, 24.98%; and niacin, 14.58%. The change of some minerals and proximate composition after blanching was investigated while the quantities of Na and Cu increased, Zn, Fe, Ca, K, and P quantities decreased. Fat content was the same, protein content decreased 19.24%, moisture level increased 0.25%, ash content increased 63%, and total carbohydrate increased 0.79%.

In this study, mushrooms were examined with respect to their proximate composition, water soluble vitamins, and minerals, every 1.5 months after they were canned; for a period of 6 months storage.

MATERIALS AND METHODS

Whole fresh button mushrooms (*Agaricus bisporus*) were put into 370 ml jars. Each jar contained 200 g of mushrooms. They were sterilized with steam vapor for 18 min. at 121C. After the steam treatment, jars were filled with brine containing 2% NaCl and 0.2% citric acid. The brine was first sterilized and then added under aseptic conditions. The canning was carried out in a modern processing plant and was their standard process. Jars were stored at room temperature for six months and analyzed every 1.5 months during that period.

Proximate composition of ash (AOAC 29.013), fat (AOAC 22.034), moisture (AOAC
Nutritive changes of canned mushrooms (*Agaricus bisporus*)

22.003 & 22.008) and protein (AOAC 1990, PN-75/A-04018) were determined using standard methods\(^1\). Total amount carbohydrate was found by subtracting the amount of ash, protein, and fat from total dry matter. Nitrogen was determined by Kjeldahl analysis, multiplied by 6.25 and reported as protein.

Vitamins were analyzed by several methods\(^1,2,9,12\) outlined for the analysis of water soluble vitamins. The exact methods used were: for B1 pages 65-61, for B2 pages 68-61, for C pages 239-242, for folic acid pages 179-185, for pantothenic acid pages 213-220, and for niacin pages 192-200, all in Strohecker and Henning\(^12\).

The minerals Ca, Cr, Cu, Fe, K, Na, and Zn were determined according to the AOAC\(^1\). Potassium and sodium were determined with flame emission techniques. The others were determined with atomic absorption spectrophotometer. All of the elemental analyses, except P, were done using a Pye Unicam, Mode(SPB). Phosphorus was determined by spectrophotometry according to the AOAC\(^1\). Ash was dissolved in 5 ml 20% HCl, diluted and filtered through a 0.45 μ pore size filter. Lanthanum was added to overcome interferences for Ca and Mg determination\(^10\).

Immediately after canning (0-month), proximate, mineral and vitamin analyses were done in triplicate. All subsequent analyses were done in duplicate, using one sample from each of two jars. The brine was drained from the mushrooms and the surfaces patted dry. Duncan’s multiple range test was applied to all data.

**RESULTS AND DISCUSSION**

Changes in nutritive compounds during six-months are given at 1.5 month intervals in Table 1.

The fat content declined slightly during the six months; *A. bisporus* contained 0.35% fat and it had decreased by 0.05% by the last storage period. Protein content decreased 1.19%. It was estimated that protein quantity could be reduced in light acidic medium. Total carbohydrate at 0 month was 3.78%, then 3.50%, 3.43%, 2.95% and 3.84% in the last month. During storage period, it decreased slightly during the first 4.5 months, but it increased slightly in the last month. It depended on changes of other compounds because it was calculated by subtracting the other compound quantities. Moisture content increased slightly during storage; since mushrooms were kept in brine, they could absorb moisture. The increase in ash content was probably from the brine, which contain salt and could contribute to ash quantity.

The Zn, K, P quantities decreased, Cu, Ca, Na quantities increased, and Cr was a trace (Table 2). Decreases in Zn, K, P depended on formation of organic and inorganic compounds.

<table>
<thead>
<tr>
<th>Nutrients (%)</th>
<th>0-month</th>
<th>1.5 months</th>
<th>3 months</th>
<th>4.5 months</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>0.35</td>
<td>0.32</td>
<td>0.33</td>
<td>0.31</td>
<td>0.30</td>
</tr>
<tr>
<td>Protein</td>
<td>3.43</td>
<td>3.44</td>
<td>3.02</td>
<td>3.11</td>
<td>2.24</td>
</tr>
<tr>
<td>Moisture</td>
<td>91.73</td>
<td>91.56</td>
<td>91.90</td>
<td>91.95</td>
<td>92.02</td>
</tr>
<tr>
<td>Ash</td>
<td>0.71</td>
<td>1.18</td>
<td>1.32</td>
<td>1.68</td>
<td>1.60</td>
</tr>
</tbody>
</table>

Differences between replicate analyses were never statistically significant (Duncan’s P<0.05).

Table 2. The mineral contents of fresh mushrooms (ppm), from 0 month and during storage every 1.5 months, up to six months

<table>
<thead>
<tr>
<th>Minerals</th>
<th>0-month</th>
<th>1.5 months</th>
<th>3 months</th>
<th>4.5 months</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zn</td>
<td>5.46</td>
<td>4.04</td>
<td>2.31</td>
<td>1.95</td>
<td>1.70</td>
</tr>
<tr>
<td>Cu</td>
<td>1.59</td>
<td>2.34</td>
<td>3.96</td>
<td>3.98</td>
<td>3.79</td>
</tr>
<tr>
<td>K</td>
<td>2245.50</td>
<td>544.5</td>
<td>357.46</td>
<td>240.25</td>
<td>140.40</td>
</tr>
<tr>
<td>Na</td>
<td>171.59</td>
<td>596.89</td>
<td>863.55</td>
<td>3136.57</td>
<td>6596.13</td>
</tr>
<tr>
<td>Fe</td>
<td>8.73</td>
<td>6.36</td>
<td>6.30</td>
<td>6.22</td>
<td>9.20</td>
</tr>
<tr>
<td>Ca</td>
<td>39.60</td>
<td>18.97</td>
<td>42.85</td>
<td>50.97</td>
<td>68.06</td>
</tr>
<tr>
<td>Cr</td>
<td>tr</td>
<td>tr</td>
<td>tr</td>
<td>tr</td>
<td>tr</td>
</tr>
<tr>
<td>P</td>
<td>882.30</td>
<td>687.40</td>
<td>550.30</td>
<td>460.95</td>
<td>446.40</td>
</tr>
</tbody>
</table>

Differences between replicate analyses were never statistically significant (Duncan’s P<0.05).

Table 3. The vitamin quantities of fresh mushroom (mg/100g), from 0-month and during storage every 1.5 months, up to six months.

<table>
<thead>
<tr>
<th>Vitamins</th>
<th>0-month</th>
<th>1.5 months</th>
<th>3 months</th>
<th>4.5 months</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1 (thiamine)</td>
<td>0.094</td>
<td>0.050</td>
<td>0.038</td>
<td>0.032</td>
<td>0.028</td>
</tr>
<tr>
<td>B2 (riboflavin)</td>
<td>0.396</td>
<td>0.230</td>
<td>0.209</td>
<td>0.192</td>
<td>0.176</td>
</tr>
<tr>
<td>Folic acid</td>
<td>0.078</td>
<td>0.035</td>
<td>0.029</td>
<td>0.025</td>
<td>0.020</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>5.72</td>
<td>3.24</td>
<td>2.98</td>
<td>2.74</td>
<td>2.31</td>
</tr>
<tr>
<td>Panthotenic acid</td>
<td>2.29</td>
<td>1.58</td>
<td>1.36</td>
<td>1.28</td>
<td>1.22</td>
</tr>
<tr>
<td>Niacin (PP)</td>
<td>5.35</td>
<td>4.46</td>
<td>4.35</td>
<td>4.31</td>
<td>4.29</td>
</tr>
</tbody>
</table>

Differences between replicate analyses were never statistically significant (Duncan’s P<0.05).

of these elements and solving of those in the brine. Increased Cu, Na, Ca, might have originated in the brine. The 2% NaCl and 0.2% citric acid were commercial grade and they had impurities. The Cu and Ca might also have been leached from the glass jars. Absorption of metallic element impurities could cause a little increase in the weight of mushrooms. We could not compare above results with literature since we could not find similar research during our literature review. However, some similarities can be seen in the data of Watt and Merrill[13].

As seen in Table 3, all water soluble vitamins decreased during the storage period. The vitamins decreased: B1, 3.357; B2, 2.25; folic acid, 3.9; vitamin C, 2.476; pantothenic acid, 1.71; and niacin, 1.24 times by the end of storage period (six months).

While percent composition is a common and reasonable way to express the composition of foods, it can be misleading, especially when it expresses change. We may reasonably assume that once canned, most nutrients remain in the container. Most are water soluble and would be expected to leach out of, or in a few cases into, the mushrooms. While some nutrients are being dissolved from the mushrooms, the quantity replaced by water and salt must be still
greater. Thus, while the losses to the brine are real, the analysis apparently overestimates the total loss to the edible material in the mushrooms.

Although losses may be less than percentages suggest, canning mushrooms can cause a considerable loss of water soluble vitamins. If biochemical reactions and microbiological activity can be prevented in fresh mushrooms by some preservation methods like freezing, packaging and storage under modified atmosphere and inhibition of enzymes by some chemicals, the fresh mushrooms can keep their nutritional quality and have a long shelf-life. They might then be like fresh products that have not had any food preservation treatment.

LITERATURE CITED


