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# Mushroom and mushroom-vegetable pastes from wild edible mushrooms

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In this investigation mushroom and mushroom-vegetable pastes were produced from different edible fungi (*Tricholoma equestre*, *Cantharellus cibarius* and *Xerocomus badius*) in fresh, frozen or dried state, as well as from mushroom marc after juice extraction. Sauerkraut, brined cucumbers, tomato concentrate, red pepper, carrots etc. has been used as the components of the mushroom-vegetable pastes. From the long list of different compositions a few were selected for their accepted organoleptic value. The principles of the technological process are described. The pastes were stable during three months of storage at 12° C.

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## Material and methods

Fruit-bodies of *Tricholoma equestre* (L. ex Fr.) Quél, *Cantharellus cibarius* Fr. and *Xerocomus badius* (Fr.) Kühn were collected from pine woods in western Poland (Miedzychód region) in the autumns of 1973-1976 in 25-40 kg samples and kindly supplied by the company "Las". According to Polish Norm $\frac{PN-76}{R-7859}$ the mushrooms were of the first quality class.

Dry weight (at 105° C), titrable acidity, esters (as ethyl acetate) and Kjeldahl N were measured by standard methods, and protein N and $NH_2$-N according to Bielozierski (1954). The sodium, potassium and calcium contents were estimated in a Carl Zeiss Flame-photometer, model III. Samples were dried, carbonized and finally ashed in a muffle furnace at 550° C for 3 h. The redistilled water + HCl (a few drops) solution of ash was freed from phosphates by using ion exchange resin Reoxin 201. Zinc and iron were determined polarographically using OH 102 Redelkis polarograph. Samples were wet mineralized in a mixture of $HNO_3$ and $H_2SO_4$. For sensory evaluation the five-unit organoleptic method of Tilgner (1957) was used.

The technological process of paste production is shown in Fig. 1. Mushrooms were pulped in a Rietz disintegrator and homogenized in a Frym homogenizer with 0.55 mm slit. Mushroom marc was obtained after pressing the pulp in the Bücher-Gyuer AC, TPZ-7 layer press of pilot plant scale.

*X. badius* was dried after slicing in air blast dryer at 50-60° C during 12 h to 6% water content and extracted after crushing in the laboratory Quickfit extractor at 50° C. The marc after extraction was used for paste production.

## Results and discussion

As stated in the previous paper (Woźniak & Sobkowska 1978) mushroom juice concentrate production leaves a large amount of marc (30-40% of raw material weight) containing much of the aromatic and nutritive substances of the fruit-bodies (Table 1). The second grade frozen mushrooms also offer much product that can be processed further into mushroom and mushroom-vegetable pastes (Sobkowska & Woźniak 1978).

In these investigations different compositions of mushroom and mushroom-vegetable pastes were prepared. Whole fruit-bodies of *T. equestre* were found to be a good material for mushroom paste production

Table 1. Composition of marc of *Tricholoma equestre* as percent of total content in mushroom

| Compound | Marc from mushrooms | |
|---|---|---|
| | Fresh, recovery% | Frozen, recovery% |
| Dry weight | 75 | 65 |
| Titrable acids | 58 | 56 |
| Esters | 55 | 51 |
| Total N | 67-75 | 65-71 |
| Protein N | 67-73 | 72-76 |
| $NH_2$-N | 68-73 | 45-50 |
| Ca | 60 | 55 |
| Na | 35 | 30 |
| K | 32 | 25 |
| Zn | 66 | 63 |
| Fe | 80 | 70 |

(disintegration, homogenizing, addition of 10% of oil fried with onion and/or 2% of salt, and sterilization, as shown in Fig. 1). For this purpose fresh and frozen mushroom could be used, as well as the marc after juice pressing. In the last mentioned case the organoleptic scores have been about 0.5 unit lower owing to the poorer taste and aroma characteristics (Table 2).

The bitter taste makes the problem of paste production from *C. cibarius* more complicated, especially when marc was used. Therefore this mushroom has been found more suitable as material for two-component and mushroom-vegetable pastes than for single mushroom paste production. The situation was similar with *X. badius*, but the limiting factor for single mushroom paste production was the very intensive aroma and rancid taste that caused the low organoleptic evaluation notes (Table 2).

In Tables 2 and 3 some compositions of mush-

Fig. 1. Technological process for paste preparation.

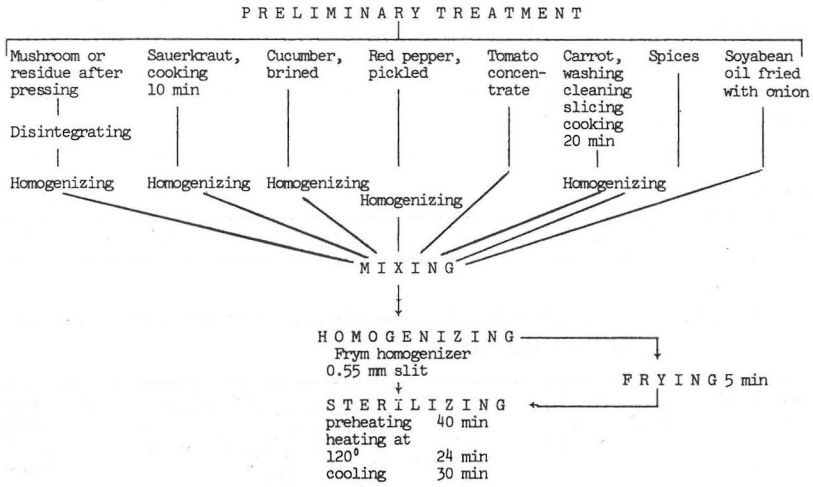


Table 2. Effect of composition on the organoleptic value of mushroom and mushroom-vegetable pastes from *Tricholoma equestre*, *Xerocomus badius* and *Cantharellus cibarius*

| Component | Composition % | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *T. equestre* | | | | | | | | | | | |
| pulp | 98 | - | - | - | - | - | - | - | - | - | - |
| marc from fresh | - | 98 | - | 56 | 50 | 45 | - | - | 30 | - | - |
| marc, frozen | - | - | 98 | - | - | - | 45 | - | - | - | - |
| marc, frozen, stored 24 months | - | - | - | - | - | - | - | 45 | - | - | - |
| *X. badius* | | | | | | | | | | | |
| pulp | - | - | - | - | - | - | - | - | 39 | 98 | - |
| marc after extraction | - | - | - | 24 | - | - | - | - | - | - | - |
| sauerkraut | - | - | - | - | 24 | 17 | 17 | 17 | 6 | - | - |
| red pepper | - | - | - | 7 | - | 21 | 21 | 21 | 6 | - | - |
| cucumber | - | - | - | - | 24 | 15 | 15 | 15 | - | - | - |
| tomato concentrate | - | - | - | - | - | - | - | - | 8 | - | - |
| carrot | - | - | - | 8 | - | - | - | - | 6 | - | - |
| soyabean oil | - | - | - | 3 | - | - | - | - | 3 | - | - |
| salt | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| spices | - | - | - | + | - | - | - | - | - | + | + |
| *C. cibarius* | | | | | | | | | | | |
| marc | - | - | - | - | - | - | - | - | - | - | 98 |
| Organoleptic value | 4.0 | 3.6 | 3.4 | 4.1 | 4.2 | 4.6 | 4.5 | 4.2 | 4.1 | 2.8 | 2.0 |

Table 3. Effect of the composition on the organoleptic value of mushroom marc-vegetable pastes from *Tricholoma equestre*, *Cantharellus cibarius* and *Xerocomus badius*

| Component | *Tricholoma equestre* | | | | | *Cantharellus cibarius* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | % | % | % | % | % | % |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Residue after pressing | 66 | 63 | 50 | 50 | 45 | 80 | 80 | 76 | 67 | 60 | 60 | 49 | 34 |
| Sauerkraut | - | 20 | 6.5 | 24 | - | - | - | - | - | - | - | - | - |
| Red pepper | 16 | 15 | 6.2 | - | 21 | - | - | - | 15 | - | - | 19 | - |
| Cucumber | - | - | 6.5 | 24 | 32 | - | - | - | - | - | - | - | - |
| Tomato concentrate | - | - | - | - | - | - | 10 | 8 | 8 | 19 | - | 10 | 24 |
| Carrot | - | - | 6.3 | | | 12 | - | 10 | - | - | - | - | 34 |
| Soyabean oil | 15 | - | 10 | - | - | 4.5 | 8 | 4 | 10 | - | 10 | 10 | 5 |
| Horse-radish | - | - | 12 | - | - | - | - | - | - | - | - | 8 | - |
| Salt | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| *X. badius* pulp | - | - | - | - | - | - | - | - | - | 19 | 28 | - | - |
| Organoleptic value | 4.1 | 4.2 | 4.0 | 3.9 | 4.3 | 2.0 | 4.4 | 4.3 | 3.8 | 4.7 | 4.6 | 2.0 | 4.2 |

Table 4. Effect of storage at 12° C on the chemical and organoleptic evaluation of mushroom-vegetable pastes

| Sample of marc | Paste No.* | Storage time, months | Content in 100 g of paste | | | | pH | Mean organoleptic score |
|---|---|---|---|---|---|---|---|---|
| | | | Dry weight g | Titrable acidity ml 0.1 n NaOH | Volatile acid ml 0.1 n NaOH | Total N g | | |
| *Tricholoma equestre* | 1 | 0 | 19.7 | 45.0 | 10.0 | 1.8 | 4.9 | 4.1 |
| | | 3 | 19.7 | 46.3 | 11.0 | 1.8 | 5.0 | 4.4 |
| | 2 | 0 | 12.1 | 62.5 | 16.0 | 1.9 | 4.6 | 4.2 |
| | | 3 | 12.0 | 65.0 | 17.0 | 1.9 | 4.7 | 4.2 |
| | 3 | 0 | 18.6 | 55.0 | 8.5 | 1.8 | 4.6 | 4.0 |
| | | 3 | 18.6 | 55.0 | 10.0 | 1.8 | 4.7 | 4.0 |
| | 4 | 0 | 10.6 | 52.5 | 9.7 | 1.7 | 4.5 | 3.9 |
| | | 3 | 10.7 | 52.3 | 10.5 | 1.7 | 4.5 | 4.1 |
| | 5 | 0 | 9.9 | 70.0 | 24.5 | 1.3 | 4.3 | 4.3 |
| | | 3 | 9.9 | 70.0 | 24.5 | 1.3 | 4.4 | 4.3 |
| *Cantharellus cibarius* | 6 | 0 | 19.8 | 25.0 | 0.5 | 2.4 | 4.5 | 2.0 |
| | | 3 | 19.9 | 26.3 | 0.5 | 2.4 | 4.5 | 2.0 |
| | 7 | 0 | 23.9 | 60.0 | 0.7 | 3.7 | 5.8 | 4.4 |
| | | 3 | 24.0 | 60.0 | 0.7 | 3.7 | 5.8 | 4.1 |
| | 8 | 0 | 16.6 | 62.5 | 1.5 | 4.2 | 4.8 | 4.3 |
| | | 3 | 16.6 | 62.5 | 1.5 | 4.2 | 4.8 | 4.3 |
| | 9 | 0 | 14.4 | 50.0 | 11.5 | 2.6 | 4.2 | 3.8 |
| | | 3 | 14.5 | 50.0 | 13.5 | 2.6 | 4.3 | 3.9 |
| | 10 | 0 | 16.5 | 33.7 | 1.0 | 2.8 | 5.3 | 4.7 |
| | | 3 | 16.5 | 35.0 | 1.0 | 2.8 | 5.4 | 4.5 |
| | 11 | 0 | 16.4 | 38.7 | 0.7 | 3.0 | 5.4 | 4.6 |
| | | 3 | 16.3 | 38.8 | 1.0 | 3.0 | 5.4 | 4.6 |
| | 12 | 0 | 22.6 | 70.0 | 15.0 | 2.5 | 4.3 | 2.0 |
| | | 3 | 22.8 | 71.3 | 16.0 | 2.5 | 4.2 | 2.0 |
| | 13 | 0 | 30.0 | 85.0 | 2.0 | 2.5 | 4.0 | 4.2 |
| | | 3 | 30.0 | 85.5 | 2.2 | 2.5 | 4.0 | 4.3 |

* As in Table 3.

room marc-vegetable paste are shown, and Table 4 shows the influence of time of storing at 12° C on the chemical and organoleptic characteristics of the pastes listed in Table 3.

As can be seen from Tables 2 and 3, sauerkraut, red pepper and cucumber are good components of *T. equestre* paste; carrot and horse-radish can also be used. Tomato concentrate has been eliminated due to the bad colour effect. Addition of *X. badius* pulp was rather neutral. Paste obtained from the marc of frozen mushrooms, stored for as long as two years, were of good organoleptic value.

In *C. cibarius* paste (Table 3) the addition of *X. badius* pulp was beneficial for the taste and aroma characteristics, tomato concentrate has also been a good component giving the paste an attractive colour. The addition of red pepper or, even more, of horse -radish caused reduced notes and disqualification.

The pastes obtained were stable chemically and organoleptically during three months of storage at 10-12° C.

References

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