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On the storage of some fresh wild mushrooms

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Mushrooms are usually considered as easily perishable products. Very little information is available in the literature on storage keepability of fresh wild mushrooms.

The possibilities of keeping fresh wild mushrooms in cold storages have been studied at the University of Helsinki, Department of Food Chemistry and Technology, using the crops of 1975 and 1976. Different packing materials and storage temperatures were used. Organoleptic methods were used to follow up quality changes in mushrooms. Some respiration measurements were also made.

The best packing material was polyethene. The storage time varied from some days to several weeks. Great differences were observed with different mushroom species.

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Introduction

The storage stability of mushrooms is usually considered to be poor. Numerous research papers have been published about the effect of different parameters such as storage temperature (Sveine et al. 1967), oxygen and carbon dioxide content of storage atmosphere (Murr & Morris 1975 b), different packaging materials (Nicholas & Hammond 1973, 1974, 1975, 1976, Sveine et al. 1967, Gormley & MacCanna 1967), etc., on the storage of champignon (*Agaricus bisporus*). Usually lowering of storage temperature, lowering of oxygen content in storage room, using plastic films, and also using radiation increased the storage stability of the champignon. In all the papers mentioned storage stability has been measured by respiration intensity measurements. The respiration intensity of mushrooms is much higher than that of other materials of plant origin (Hammond & Nichols 1975). This is believed to have a fundamental effect on the storage stability of mushrooms (Sveine et al. 1967, Lutz & Hardenburg 1968, Ryall & Lipton 1972). Darkening of the color and toughening of the structure have been observed (Murr & Morris 1975 a, Goodenough 1976, MacCanna & Gormley 1969) when storage experiments have been made with champignon.

Depending on the criteria used, different storage times have been reported for champignon. Very little information is available on the storage times of wild forest mushrooms.

The purpose of this study was to obtain a rough idea of how long different wild mushrooms growing in Finland could be stored fresh at different temperatures and in different packaging materials. Tests have been carried out from both 1975 and 1976 crops. Organoleptic as well as some respiration measurements were used to describe spoilage.

Materials and methods

Several mushroom species were used (Table 1), but because of lack of fresh material complete testing was not possible with every species. All the material was picked by the research staff and the experiments were initiated within 6-8 hours from picking. If this was not possible the mushrooms were stored at 4° C. (Some fresh mushrooms were bought from commercial sources and the exact time of picking was not known). The mushrooms were cleaned according to normal commercial practice before use.

Three packaging materials were used: aluminium foil, polyethene (LD, 0.03 mm) and paper (imitating unpacked material). For each package 100 g of sample was used. Aluminium foil was not used in the 1976 experiments.

The mushrooms were stored at three different temperatures: +4, +10, and +20° C. Temperature 20° C was not used in the 1976 experiments. Organoleptic analysis was conducted at different intervals.

Table 1. Mushroom species used in the study. Mushrooms were cleaned according to normal commercial practice before use.

Mushroom species used	Crop of 1975	Crop of 1976	Comments
Lactarius trivialis	x	x	
Lactarius rufus I	x	x	Rainy weather
Lactarius rufus II		x	Dry weather
Cantharellus cibarius		x	
Tricholoma flavovirens		x	
Tricholoma portentosum		x	
Armillariella mellea		x	
Hydnum rufescens		x	
Agaricus bisporus		x	As reference

In organoleptic measurements a scoring method (Amerine et al. 1965) was used. A verbal scale ranging from excellent to bad was given to panelists and changed into numbers (5-1) for analysing the results. Colour, smell, texture and taste were analysed separately. As discussed above, both colour and texture of the champignon changes during storage. Fresh control samples were not available at each testing. Taste was analysed after boiling the mushrooms for 5 min at 1.5% NaCl solution using mushroom to water ratio of 1:9. An expert panel of 6 persons was used, all members belonging to the laboratory staff. Samples were considered spoiled when at least one of the properties judged received scores below or equal to 2.0 (slightly bad).

Respiration was measured with a Warburg manometer (Umbreit et al. 1957, Rast 1961, Hou & Wu 1972) using 0.02 M KH_2PO_4 solution (Ap Rees & Bryant 1971). Before measurements the mushrooms were cleaned an the gills were removed from *Lactarius, Armillariella, Tricholoma* and *Cantharellus*. Two to four mushrooms were sliced to 0.5 mm slices. Round Ø 6 mm pieces were cut and 0.125-0.500 g of these pieces were weighed for each measurement so that half of the pieces were from the cap and the rest from the foot. Both oxygen consumption and carbon dioxide production were measured and calculated to the fresh weight. Oxygen consumption was also calculated to the volume and area of the sample (Kovács & Vas 1974 b). The RQ value was calculated by dividing the amount of CO_2 released by the amount of O_2 consumed.

Results and discussion

Storage times of different mushroom species can be seen in Table 2 together with the limiting property.

Table 2. Storage time of different mushroom species at +4° C.

Mushroom species	Packaging material	Storage time, days crop of 1976	1975	Limiting property 1976	1975
Lactarius trivialis	Paper	19	15	Taste	Colour
	Polyethene	27	16(12)	Smell	Smell
	Al-foil	-	8	-	Texture
Lactarius rufus I	Paper	22	9	Texture	Texture
	Polyethene	45	>23	Taste	-
	Al-foil	-	7	-	
Lactarius rufus II	Paper	23	-	Texture	
	Polyethene	39	-	Taste	
	Al-foil	-	-	-	
Cantharellus cibarius	Paper	24		Texture	
	Polyethene	95	-	Taste	
	Al-foil	-	-	-	
Agaricus bisporus	Paper	20	-	Texture	
	Polyethene	24	-	Smell	

Storage time of different mushroom species at +10° C.

Mushroom species	Packaging material	Storage time, days crop of 1976	1975	Limiting property 1976	1975
Lactarius trivialis	Paper	21	10	Taste	Smell
	Polyethene	27	15	Taste	
	Al-foil	-	5	-	Taste
Lactarius rufus I	Paper	22	9	Texture	Taste
	Polyethene	32	>23	Smell	
	Al-foil	-	2	-	
Lactarius rufus II	Paper	26	-	Texture	
	Polyethene	33	-	Smell	
	Al-foil	-	-	-	
Cantharellus cibarius	Paper	42	-	Texture	
	Polyethene	100	-	Taste	
	Al-foil	-	-	-	
Agaricus bisporus	Paper	18	-	Taste	
	Polyethene	18	-	Taste	

The storage times of the wild mushrooms studied differed very little at the different storage temperatures tested, in contrast to the champignon which had a considerably longer storage time at +4° C than at 10° C. Similar results have been published earlier (Dredge 1964, Hughes 1959, Gormley 1975). Wild mushrooms had longer storage times than champignon. Polyethene was by far the best packaging material out of the three used. The packaging material seems to affect the storage time more than the temperature. The limiting property of mushrooms packed in paper bags was in most cases structure. This is most probably due to the drying of mushrooms during storage. In polyethene bags the limiting property was smell or taste. This is most probably due to the high humidity in the bag (Gormley & MacCanna 1967). Colour does not seem to be very important, perhaps because of the dark colours and the great differences in colour of fresh mushrooms. Aluminium foil proved not to be applicable for the packing of mushrooms.

The purpose was to measure the respiration of all mushrooms used in the storage experiments but problems in the respiration measurements delayed the experiments so much that fresh material was no longer available (Table 3).

Table 3. RQ values of mushrooms.

Mushroom species	RQ
Cantharellus cibarius	0.54
Tricholoma flavovirens	0.81
Armillariella mellea	0.78
Hydnum rufescens	0.42
Agaricus bisporus	0.76

Cantharellus cibarius has a very low RQ value and good storage stability. The RQ of *Agaricus bisporus* is comparable to the results of Hou & Wu (1972); other values have been registered with different methods (Kovács & Vas 1974 a). The cutting of mushrooms used in our experiments increases the respiration rate (Appleman & Brown 1946, Laties 1957, Hruschka 1967). Also the removal of gills affects the results because the respiration rate is greatest at the gills.

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