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RESEARCH ARTICLE

Effect of different stipe length, pre-cooling and perforation in polypacks on keeping quality of *Agaricus bisporus* (Lange) Sing. at different storage temperatures

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ABSTRACT

Button mushroom, *Agaricus bisporus* (Lange) Sing. has very short shelf-life at ambient temperature after harvest. It was found that shelf-life of button mushroom can be increased by keeping at 5°C temperature. Further, at 5°C temperature whiteness remained excellent up to 144 hrs of storage duration without veil opening followed by 12 and 18°C temperature with smallest stipe length (0.5cm) without veil opening and good whiteness up to 96 hrs of storage duration. Shelf-life of white button mushroom in 100 gauge polythene bags without perforation is found best at 5°C and excellent whiteness was observed up to 120 hours of storage duration with no veil opening and with good whiteness up to 144 hrs of storage at 5°C. Whereas, it remain excellent white up to 72 hours and 48 hours of storage at 12 and 18°C temperature with no veil opening, respectively. Pre-cooling of sporophores of *A. bisporus* improved its keeping quality considerably. However, pre-cooling for 10 hours at 0°C was found to be the best pre-cooling duration for post-harvest preservation of button mushroom as fruit bodies retains good whiteness with no veil opening up to 120 hours of storage duration at 5 and 12°C temperature. Whereas, good whiteness and no veil opening was found only up to 96 hours of storage at 18°C.

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INTRODUCTION

Mushrooms are highly perishable and get spoiled due to wilting, veil-opening, browning, liquefaction, loss of texture, aroma, flavour, etc. making them unsaleable (Azad *et al.,* 1987). Earlier it was believed that the primary cause of spoilage of fresh button mushroom is enzymatic reactions in the living tissue. Later it was suggested that mushroom spoilage might be caused by the action of bacteria on the mushroom tissue and browning of mushroom was due to a combination of autoenzymatic and microbial action on the tissue.

Ajlouni *et al.* (1992) reported that stipe trimming at harvest increases the shelf-life of the fresh mushroom (*Agaricus bisporus*). During post-harvest development, dry matter is transferred from stipe to pileus. The stipe appears to be a major source for the pileus since when it is trimmed prior to storage; pileus opening and mushroom senescence are delayed. This relationship between pileus and stipe stiffness probably reflects the depletion of resources from the stipe to support the continual hyphal growth in the pileus.

The temperature of the button mushroom after picking varies between 15 to 18°C and it rises steadily during the storage due to respiration and atmospheric temperature. This heat causes deterioration in quality. Hence, the heat should be removed immediately after the harvest and the temperature of mushroom should be brought down to 4 to 5°C as quickly

as possible. It has been estimated that mushrooms at a temperature of 10°C have 3.5 times higher respiratory capacity than those at temperature of 0°C which necessitates immediate shifting of mushroom to the refrigerated zone.

There is no chilling injury to button mushroom, *Agaricus bisporus* at temperatures as low as 1.5°C. The respiration rates were found to decrease with temperature and reduction in temperature resulted in the best appearance of mushroom. The critical O_2 and CO_2 concentration were found to be 1.5-2 per cent and 12 per cent, respectively (Halachmy and Mannheim, 1991). Gormley (1975) stated that the time of storing mushroom into the refrigerator (1°C) and the time of removal, affected whiteness during subsequent storage at room temperature.

Thus, the mushrooms are required to be packed in the proper packaging with proper air exchange immediately after harvesting to check the high rate of respiration and fast deterioration. Keeping quality of the white button mushroom is also affected by perforated and non-perforated packing polybags.

Minamide *et al.* (1985) reported that *A. bisporus* stored at 20°C deteriorated rapidly resulting in a shelf-life of only one day but low storage temperature (1°C) suppressed this deterioration and extended the shelf-life to 15 days. To increase the shelf-life of button mushrooms Modified Atmosphere Packaging (MAP) has been shown successfully to delay senescence and maintain quality after harvest (Tano *et al.,* 1999; Roy *et al.,* 1995; Saray *et al.,* 1994; Lopez Briones *et al.,* 1993; Burton and Maher, 1991 and Henze, 1989).

Saxena and Rai (1988) used non-perforated polythene bags for the storage of button mushroom for 4 days at 5°C but for transporting mushrooms to long distance polythene bags cannot be used for packing. Chopra *et al.* (1985) recommended 100 gauge polythene bags with 0.5 per cent perforated area for packing mushrooms in case of refrigerated storage. Murr and Morris (1974) reported that 0 per cent O_2 was needed to arrest O-phenol oxidase activity and brown discolouration of the cap in mushrooms. A atmosphere containing 1 per cent O_2 and/or 5 per cent CO_2 prevented cap opening of mushroom for up to five weeks at 0°C.

MATERIALS AND METHODS

To study the effect of stipe length on the shelf life of *A. bisporus*, an experiment was conducted in which white button mushroom of same size, shape and uniform age were taken but the length of stipe is of different size. The stipe length was cut/trimmed *viz.,* 0.5, 1.0, 1.5, 2.0 and 2.5cm. To see the effect of pre-cooling on the shelf-life of *A. bisporus*, an experiment was conducted in which white button mushroom of same size, shape and uniform age were pre-cooled at 0°C for 4, 6, 8 and 10 hours duration before keeping it for storage. White button mushrooms without pre-cooling served as control. To find out the effect of different perforated area of the polythene bags on the keeping quality of *A. bisporus*, an experiment was conducted in which different perforated areas such as 0 per cent (control), 0.5 per cent, 1 per cent, 1.5 per cent, 2 per cent and 2.5 per cent perforation were made for aeration. For each replication four fruit bodies were packed in each polythene bag (18cm x 15cm size, 100 gauge thickness) and kept at different temperatures *viz.*, 5, 12 and 18°C. Four replications were maintained for each treatment. Observations were recorded after 24, 48, 72, 96, 120 and 144 hrs of storage, on whiteness, browning, veil opening and spoilage.

RESULTS AND DISCUSSION

Stipe length plays an important role in keeping quality of the white button mushroom. Hence, keeping this view in mind, an experiment was carried out to know the effect of different lengths of stipe on shelf-life of mushroom. The data presented in Table 1 and Fig.1(a) reveal that the quality of mushroom can be maintained up to 96 hrs at 12 and 18°C with smallest stipe length (0.5cm) without veil opening. At 5°C temperature whiteness remained excellent (+++) up to 144 hrs of storage duration without veil opening. As the stipe length was increased keeping quality remained good only up to 24-48 hrs of storage period at 12 and 18°C, whereas, whiteness

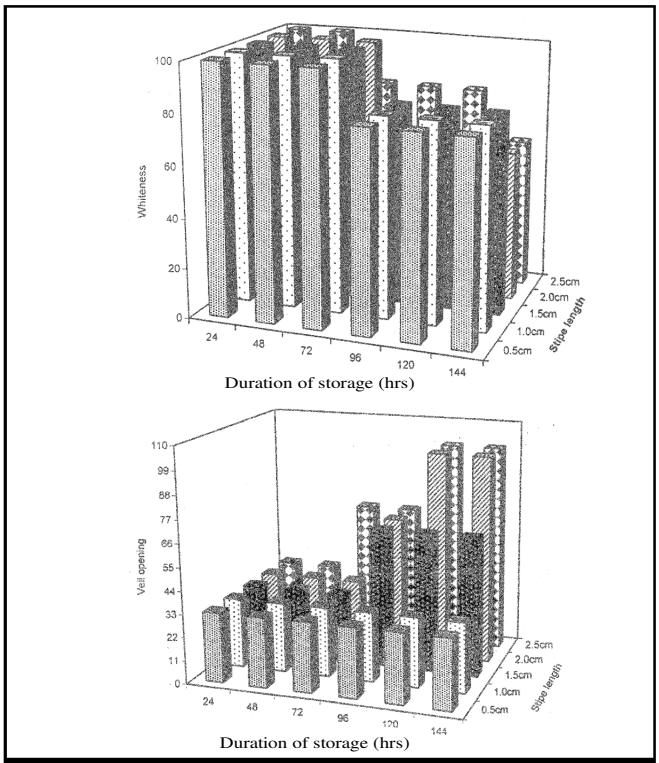


Fig. 1a: Effect of stipe length on whiteness and veil opening of *Agaricus bisporus* for different storage durations at 5°C temperature

remained excellent even after veil opened completely. Mushroom with short stipe length showed significant increase in keeping quality with less colour change and no veil opening as compared to longer stipe length treatments. Thus, it can be concluded that stipe length of 0.5cm may enhance the storage life of white button mushroom up to 24-48 hrs at 12 and 18°C.

These results are in confirmation with Ajlouni *et al.* (1992) during post-harvest development, dry matter is exported from stipe to pileus. The stipe appears to be a major source for the pileus since when it is trimmed prior to storage, pileus opening and mushroom senescence are delayed. This relationship between pileus and stipe stiffness probably reflects the depletion of resources from the stipe to support continual hyphal growth in the pileus.

The white button mushroom are required to be pre-cooled immediately after harvesting to check the high rate of respiration and fast deterioration. Therefore, an experiment was carried out to know the effect of different durations of pre-cooling on shelf-life of white button mushroom. The data are presented in Table 2 and Fig.2(a). Among the different pre-cooling durations tested, 10 hrs duration proved to be best for increasing the shelf life of sporophores where minimum colour change and no veil opening was observed up to 120 hrs of storage at 5°C temperature.

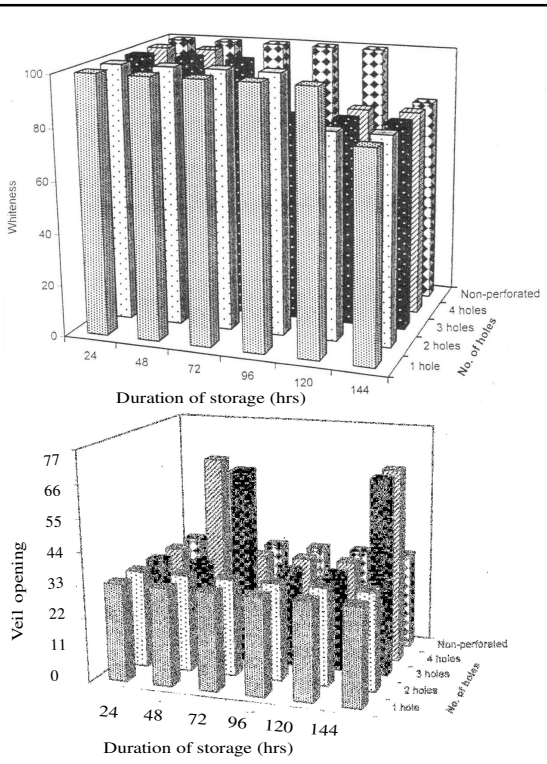


Fig. 2a: Effect of perforation in polypack on whiteness and veil opening of *Agaricus bisporus* for different storage durations at 5°C temperature

Even after 120 and 96 hrs of storage period slight colour change and no veil opening was observed at 12 and 18°C. Thus, it can be concluded that pre-cooling for 10 hrs may enhance the storage of white button mushroom up to 24-48 hrs.

The keeping quality remained better up to 96 hrs at 18°C as the pre-cooling period was increased whereas, the shelf - life was maintained only up to 72 hrs, when the pre-cooling 4-6 hrs was given. At 12 and 18°C, white button mushroom remained white only up to 48 hrs when no pre-cooling treatment was given. Thus, mushrooms pre-cooled for different durations showed significantly increased keeping quality with less colour change and reduced veil opening as compared to control *i.e.*, stored without pre-cooling. Further, these results are in confirmation with Gormley (1975) who stated that longer the refrigeration time, the sporophore remains whiter for maximum time. Burton and Twying (1989) reported the pre-cooling at 10°C for 2 days had no effect on mushroom during storage at 18°C for 4 days.

To check the post-harvest deterioration mushrooms are required to be packed in the proper packaging with proper air exchange immediately after harvesting to check the high rate of respiration and fast deterioration during transit. Keeping quality of the white button mushroom is also affected by perforated and non-perforated polybags. Effect of different sized perforation was studied and the data presented in Table 3 and Fig.3 (a) reveal that the white button mushroom showed

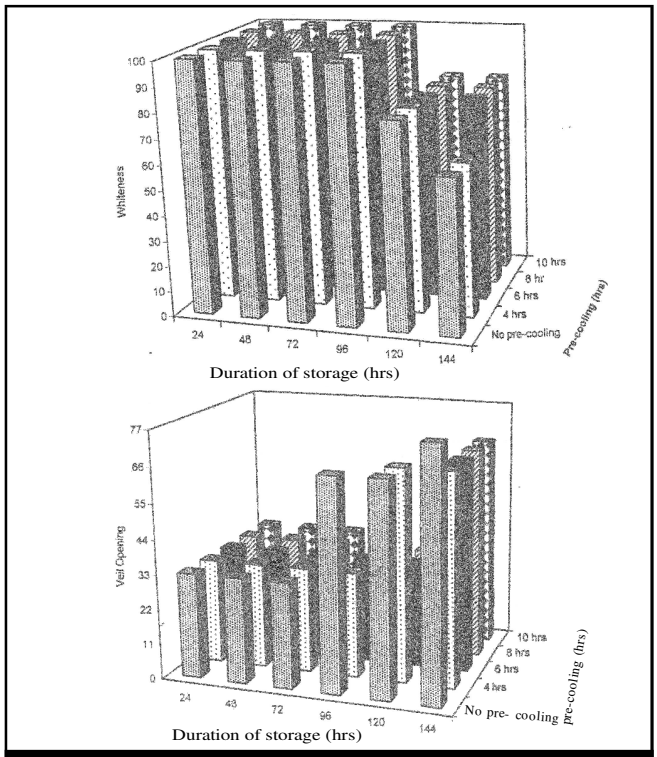
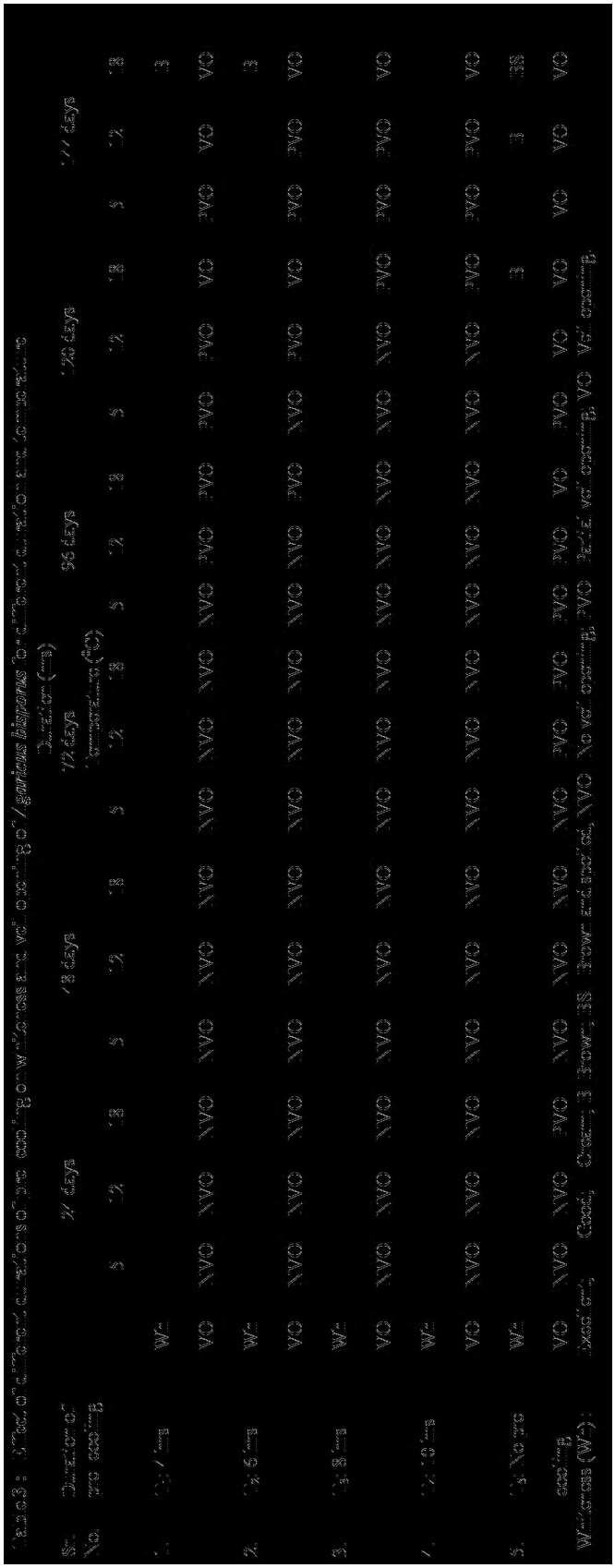


Fig. 3a: Effect of different durations of pre-cooling on whiteness and veil opening of *Agaricus bisporus* for different storage durations at 5^{0}C temperature



excellent whiteness in the non-perforated polybags as compared to perforated ones up to 72 and 48 hrs of storage duration at 12 and 18°C with no veil opening. Similarly, when mushrooms stored at 5°C temperature good whiteness (++) was observed up to 144 hrs of storage period. Moreover, veil was not opened. Similarly in the treatment with 0.5 per cent and 1 per cent perforated area the whiteness was excellent up to 48 and 24 hrs of storage period at 12 and 18°C with no veil opening. Further, at 5°C veil was remained closed up to 144 hrs of storage period with good whiteness. At 18°C temperature mushroom became brown after 86 hours of storage and spoiled after 120 hours of storage. Thus, it can be concluded that vent area/perforation of 0.5 per cent compared with non-perforation (0%) may enhance the keeping quality of white button mushroom up to 24 to 48 hrs of storage.

However, specific methods of prolonging the storage life are advisable to be adopted in lien of the specific properties of texture, aroma, browning index, respiratory rate and other metabolic activities, characteristics of a species/strain is to be worked out or studied. After harvest, the mushroom continues its physiological processes. The short life of mushroom is due to high respiration and transpiration rates. Lowering the respiration and concentration within the package is a critical parameter. The current practice in the USA is to pack fresh mushroom in plastic trays and to overwrap it with PVC film. Holes are punched on this overwrap film to allow for venting of oxygen into the package and to prevent anaerobic conditions within the package. The modified atmospheric packaging is also popular in some countries.

The findings are in confirmation with the findings of Nichols and Hammond (1973) who found that ageing as well as visual deterioration of mushroom in a over wrapped pre-pack was retarded, presumably as a result of modified O_2 and CO_2 at high R.H. Chijeong Hynn *et al.* (1996) reported that the best packaging material for keeping freshness of fresh mushrooms was polyethylene to extend the shelf-life to 15 days. Saxena and Rai (1988) used non-perforated polythene bags for the storage of button mushrooms for 4 days at 5°C for transporting mushrooms to long distance polythene bags cannot be used for packing.

REFERENCES

Ajlouni, S.O., Beelman, R.B., Tompson, D.B. and May, J. (1992). Stipe trimming at harvest increases shelf-life of fresh mushrooms, *A. bisporus. J. Food Sci.,* **57**(6):1361-1363.

Azad, K.C., Srivastava, M.P., Singh, R.C. and Sharma, P.C. (1987). Commercial preservation of mushrooms – 1. A technical profile of canning and its economics. *Indian J. Mushrooms,* **12-13**:21-29.

Burton, K.S. and Maher, M.J. (1991). Modified atmosphere packaging of mushrooms – review and recent developments. Proc. 13th Internat. Congress on the science and cultivation of edible fungi. Dublin, Irish Republic, 1-6, September 1991, pp.683-688.

Burton, K.S. and Twying, R.U. (1989). Extending mushroom storage life by combining modified atmosphere packaging and cooling. *Acta Hort.,* **258**:565-571.

Chi JeongHyun, Ha, Taemoon, Kim, TangHo, Chi, J.H., Ha, T.M. and Kim, Y.H., Ju, Y.C. (1996). Effect of storage temperature and packing method for keeping freshness fresh mushroom. *RDA J. Agric. Sci. Farm Mgmt. Agric.Engg., Sericulture & Farm Products Utilization,* **38**(1):915-921.

Chopra, S.K., Naquash, G.S. and Chadha, T.R. (1985). Effect of pre-harvest sprays of honey, citric acid and *Euphorbia royleana* latex on the shelf-life of button mushroom, *A. bisporus*. National Symp. Prod. and Con. Forestry, 12-13 April, 1985, Solan. pp.554-555.

Gormley, R. (1975). Chilling storage of mushrooms. *J. Sci. Food Agric.* 401-404.

Halachmy, I. and Mannheim, C.H. (1991). Modified atmosphere packaging of fresh mushrooms. *Packaging Technol. & Sci.,* **4**:279-286.

Henze, J. (1989). Storage and transport of *Pleurotus* mushrooms in atmospheres with high CO_2 concentrations. *Acta Hort.,* **258**:579-584.

Lopez Briones, G., Varoquaax, P., Bureau, G. and Pascat, B. (1993). Modified atmosphere packaging of common mushroom. *Internat. J. Food Sci. & Technol.,* **28**(1):57-68.

Minamide, I., Iwata, T. and Habu, H. (1985). Studies on the physiological and chemical properties and post-harvest keeping quality of mushroom. *Bulletin Univ. of Osaka Prefecture, B.* (*Agri. & Biol.*) **37**:5-12.

Murr, D.P. and Morris, L.L. (1974). Influence of O_2 and CO_2 on O-diphenol oxidase activity changes in carbon dioxide and oxygen on quality. *J. Sci. Food Agric.,* **24**:1371-1381.

Rai, R.D. and Saxena, S. (1988). Effect of storage temperature on vitamin C content of mushroom *A. bisporus. Curr. Sci.,* **57**(8):434-435.

Roy, S., Anantheswaran, R.C. and Beelman, R.B. (1995). Fresh mushroom quality as affected by modified atmosphere packaging. *J. Food Sci.,* **60**(2):334-340.

Saray, T., Balla, C., Horti, K. and Sass, P. (1994). The importance of packaging and modified atmosphere in maintaining the quality of cultivated mushrooms (*Agaricus bisporus* L.) stored in chilli chain. *Acta Hort.*, **368:**322-326.

Saxena, S. and Rai, R.D. (1988). Storage of button mushroom, *Agaricus. bisporus:* The effect of temperature, perforation of packs and pre-treatment with potassium metabisulphite (KMBS). *Mush. J. Tropics.* **8**:15-22.

Tano, K.,Arul, J.,Doyon, G. and Castaigne, F. (1999). Atmospheric composition and quality of fresh mushrooms in modified atmosphere packages as affected by storage temperature abuse. *J. Food Sci.,* **64**(6):1073-1077.

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