

## Preparation and storage of mushroom curry in retort pouches

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### ABSTRACT

Ready-to-serve mushroom 'curry' was successfully prepared, packed and stored in retortable pouches. Unblanched and sliced (longitudinal) mushrooms were used because blanched mushrooms turned darker and softer after retorting and with whole mushrooms the flushing of air was not proper which caused spoilage due to entrapped air. Moreover, whole mushrooms could not retain their shape. Retortable pouches (105  $\mu$  thick) had outer polypropylene layer (80  $\mu$ ), middle aluminium layer (12.5  $\mu$ ) and inner polyester layer (12.5  $\mu$ ); size 20x16 cm, weight 10g, seal size 10mm and lip size 4mm. In the best treatment 100g sliced mushrooms were filled in pouches followed by 50g curry concentrate (oil fried onion, garlic, ginger and spices). After sealing and over-pressure retorting at Fo 10 (final 13.2), the pouches were stored at the ambient conditions. Sensory evaluation showed that the product had high acceptability (8.25 on a scale of 10) which reduced very slightly (7.68) during storage for 12 months. No deformity, leakage or spoilage was noticed and the product remained sterile and acceptable even after 12 months of storage at the ambient conditions. Though the present study has been conducted on the common button mushroom (*Agaricus bisporus*), the technology developed can be easily extended and extrapolated to other mushrooms with slight modifications in the pretreatment, recipe ingredients and retort parameters. It is the first report of mushroom curry in retort pouch.

**Key words** : Mushroom curry, retort pouch, packaging, storage, *Agaricus bisporus*, postharvest

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Mushrooms have very short shelf-life and can not be stored fresh for more than few days even at the best conditions of storage; these are, therefore, processed in various forms for long-term storage. The mushrooms are generally dried, but the button mushroom (*Agaricus bisporus*) does not give acceptable dried product and canned in tins is the most commonly traded form<sup>13</sup>. Value-addition, while processing fruits and vegetables, is becoming

increasingly common and profitable now a days. Many studies have been carried out on processing of mushrooms into different forms like drying<sup>3,5</sup>, canning<sup>7,13</sup>, pickling<sup>8,13</sup> and steeping preservation<sup>7,12,13</sup>. It is known that product made from the stored mushroom will not have the same delicacy as prepared from the fresh. In view of the growing market for ready-to-eat/serve food items and keeping in mind the popularity of Indian 'Curry'

world over, and high cost of tin cans it was thought of importance to develop technology for ready-to-serve mushroom curry in flexible-retortable pouches. The study reported here on packing and storage of mushroom curry in retort pouch is the first report of its kind.

Flexible retort pouch is an ideal alternative to metal containers for packing and storage of heat processed foods. Flexible retort pouches, besides being cheaper, have many other advantages- easy bulk packing transport, sale and very convenient to end-user. Though the present study was conducted on most common button mushroom (*Agaricus bisporus*), the technology developed can be easily extended and extrapolated to other mushrooms with slight modifications in the pretreatments, recipe ingredients and retort parameters.

The study was carried out on following aspects:

- a. Effect of blanching
- b. Preparation of recipes
- c. Shape and size of mushrooms (whole v/s cut mushrooms)
- d. Shelf-life during storage of mushroom curry in retort pouch

Fresh white button mushroom (*Agaricus bisporus*) supplied by M/S Hindustan Lever Limited, Ooty were stored at 0-4°C in a cooling chamber. The retort pouch of 105  $\mu$  thick with polypropylene outer layer (80 $\mu$ ), aluminium middle layer(12.5 $\mu$ ) and polyester inner layer(12.5 $\mu$ ) available in the market were used.

To see the effect of blanching fresh button mushrooms were washed several times in running water and cut into 4 pieces longitudinally. To determine the effect of blanching on quality of mushroom curry, 2 kg of washed mushrooms were blanched in water for 5 minutes and then cooled immediately by dipping in cold water. The blanched mushrooms (100g) cut into four pieces longitudinally were packed in 50 g of Curry prepared using formula C described later(table 1). Unblanched cut mushrooms were filled in the same proportion as mentioned above. Five replications were maintained. All the 10 pouches were processed in the over-pressure autoclave for Fo of 12. They

were cooled, cut-open and assessed for organoleptic quality.

Curry is a liquid concoction of spices fried/sautéed in oil and ingredients used are based on individual/regional preferences. Though ready-made curry powder available in the market was used in the study but the same can be prepared by using common Indian hot spices (cumin seed, green and black cardamoms, cinnamon, bay leaves, coriander seeds, black pepper, fenugreek, nutmeg, cloves, mace etc.) In the study, effort was made to prepare a reasonably good recipe by varying the ingredients (Table 1). Three types of recipes were prepared to suit the taste of the different people.

In a frying pan, oil was added and heated.

**Table 1.** Ingredients for mushroom curry

| Ingredients       | A      | B      | C      |
|-------------------|--------|--------|--------|
| Onion             | 375g   | 510g   | 510g   |
| Garlic            | 150g   | 250g   | 250g   |
| Ginger            | 150g   | 200g   | 200g   |
| Red chilly powder | 115g   | 150g   | 150g   |
| Curry powder      | 115g   | 100g   | 100g   |
| Green chilly      | 450g   | 250g   | 250g   |
| Oil               | 180ml  | 400ml  | 400ml  |
| Salt              | 180g   | 160g   | 160g   |
| Water             | 2000ml | 1000ml | 1000ml |
| Tomato            | —      | 100g   | —      |

Sliced onions and green chillies were added to the oil and fried till golden brown. Garlic and ginger were ground into a paste, added and lightly fried till oil reappeared. Curry powder, salt, and red chilly powder were added and lightly fried. About one litre of water was added to the spices mixture and boiled till thick consistency was obtained. 100g of cut mushrooms were filled in the retort pouch and 50 g of curry mix was added using a funnel into the pouch. Five replications were maintained for A, B and C of the above mentioned recipes. The pouches were flushed in steam, sealed and heat processed in the over pressure autoclave for Fo of 12.

To study the necessity of cutting the mushrooms into pieces as followed in conventional mushroom curry preparation in households, an experiment was done with cut and uncut (whole) mushrooms. 100g of cut mushrooms were filled in the retort pouch and 50g of curry mix (recipe C) was added. Same quantity (100g) of whole mushrooms were also filled with 50g curry mix (recipe C). Five replications with whole and cut mushrooms were maintained. The pouches were sealed and processed to  $F_0$  of 12. After cooling they were cut open and evaluated.

To study the storage of the product in retort pouches, 100g of cut mushrooms were filled in the retort pouches and 50 gram of curry prepared as per formula C was added using a funnel into the pouches. The air from the filled pouches was exhausted by steam flushing<sup>10,14</sup>. Adequate number of pouches were fixed with glands and thermocouple tips inserted into the mushroom pieces for recording core temperature using Masibus Digital Temperature Scanner and Recorder<sup>16</sup>.  $F_0$  was computed by the equal time interval method described by Patastinik<sup>11</sup>. The pouches were arranged in perforated aluminium trays and loaded into a retort modified for providing over-pressure and water cooling under pressure and heat processed for 43 minutes at 121°C resulting in  $F_0$  13.2. The pouches were then cooled rapidly by spraying water under pressure. They were wiped dry and kept in dust proof cabinet at ambient temperature. Heat seal strength<sup>2</sup> and burst strength<sup>1</sup> were determined.

The post-packaging performance (shelf-life) of mushroom curry in retort pouch was evaluated every three months during the storage of 12 months. The first evaluation was done after allowing a stabilization period of 10 days. The performance of the pouch was evaluated for defects such as pin holes, wrinkles/creases on seal area, stain/rust spots, leakage of fluids, delamination of inner/outer ply etc.<sup>6</sup>. Sensory characteristics of the mushroom curry were evaluated by a 5 member

team on a ten point scale<sup>15</sup>. Sterility of the curry in pouch was determined as per IS: 2168 (1971) and pH was determined using a digital pH meter.

The curry with blanched mushrooms was not liked due to the development of dark colour and soft texture i.e. during blanching and retorting. The unblanched mushrooms were light in colour and had acceptable texture. Further experiments on curry preparation, were therefore done with unblanched mushrooms.

Organoleptic evaluation was done by a panel for taste, texture and appearance. After examination, the curry prepared using the three recipes were found good in colour, flavour and taste. The curry prepared with recipe A was more liquid than B & C. This is suitable for those who prefer to eat with rice. The curry prepared from B had a flavour of tomato and suitable for those who have taste for tomato. The curry prepared with recipe A was quite thick in consistency and suitable for eating with 'chappatis'.

On evaluating the curry prepared with cut and whole mushrooms packed in retort pouches, it was found that the curry prepared with whole mushrooms could not retain its shape in the pouch. The complete air removal could not be achieved in whole mushrooms by steam flushing as in case of cut mushrooms. The entrapped air in the pouches caused bulging of pouches which could not be stored for longer period. Hence, cut mushrooms are suitable for retortable pouch packing.

The physical properties of laminate used for study are given in Table-2.

The pouch with stood the processing temperature and pressure. No delamination of outer ply and inner ply was noticed during heat processing. Defects affecting the pouch integrity such as pinholes, wrinkles/creases on seal area, staining or rust spots, leakage of fluids and determination of inner or outer laminates were not detected at any time during storage. This shows the suitability of the pouch for its use as a container for mushroom curry<sup>9</sup>.

**Table 2.** Physical properties of the laminate

|                             |    |                          |
|-----------------------------|----|--------------------------|
| Thickness                   |    | 105 $\mu$                |
| Polypropylene- outer layer  |    | 80 $\mu$                 |
| Aluminium- middle layer     |    | 12.5 $\mu$               |
| Polyester-outer layer       |    | 12.5 $\mu$               |
| Tensile strength            | MD | 451.5 kg/cm <sup>2</sup> |
|                             | CD | 425.4kg/cm               |
| Elongation at Break         | MD | 20%                      |
|                             | CD | 20%                      |
| Heat seal strength          | MD | 70.25N/25mm width        |
|                             | CD | 60.75N/25mm width        |
| Bursting strength           |    | 21 psi                   |
| Bond strength (inner layer) |    | 184gms/10mm width        |
| Bond strength (outer layer) |    | 110gm/10mm width         |
| Pouch size                  |    | 20X16 cm <sup>2</sup>    |
| Weight                      |    | 10g                      |
| Seal size                   |    | 10mm                     |
| Lip size                    |    | 4mm                      |

MD: along machine direction

CD: along cross direction

Fo value of 8-10 has been recommended for heat processing of mushrooms in brine<sup>4</sup>. In the present study Fo value of 10 (final 13.2) was attained. The higher final Fo did not affect the colour and texture of mushroom curry packed in retort pouch. The curry was delicious with attractive colour. The mushroom pieces were intact without breakage or sloughing. The consistency of curry was also very good.

The sensory evaluation of mushroom curry showed that overall acceptability was very good initially (8.25) which reduced very slightly ( 8.25 to 7.68) during the storage at the ambient for 12 months. Only three percent of pouches were found spoiled in the first month due to improper sealing.

**Table 3:** Sensory evaluation of mushroom curry in retort pouches during storage

| Characteristics       | Storage period (months) |      |      |      |      |
|-----------------------|-------------------------|------|------|------|------|
|                       | 0                       | 3    | 6    | 9    | 12   |
| Flavour               | 8.2                     | 8.1  | 8.0  | 8.0  | 7.8  |
| Texture               | 8.6                     | 8.6  | 8.4  | 8.3  | 8.0  |
| Taste                 | 8.2                     | 8.0  | 7.9  | 7.8  | 7.5  |
| Colour                | 8.0                     | 7.80 | 7.60 | 7.50 | 7.4  |
| Overall acceptability | 8.25                    | 8.12 | 7.98 | 7.9  | 7.68 |

There was no leakage, bad odour or any other spoilage. The sterility test showed that the product was completely sterile. The pH of the curry was 5.73 and remained unchanged during the storage period.

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