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Development of Ready to Eat (RTE) CO-1 Oyster Mushroom *Gravy* through Retort Processing

G Vidhya* and G Sashidevi

Department of Food science and Nutrition,

Community Science College and Research Institute (TNAU), Madurai - 625 104, Tamil Nadu, India

***Corresponding author:** M. Sc. Student, Department of Food science and Nutrition, Community Science College and Research Institute (TNAU), Madurai - 625 104, Tamil Nadu

e-mail: gvidhya227@gmail.com

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ABSTRACT

CO-1 Oyster mushroom gravy was prepared, packed in retort pouches (250 g) and processed in retort at the product temperature of 121.1°C and the corresponding F0 value of 10.5. The product was stored at ambient temperature (35±2°C) up to 180 days. The sensory scores for oyster mushroom gravy decreased significantly however the scores were rated acceptable even on 180th day. The acid value increased gradually during storage but bacteria, yeast and mould could not be detected during the entire storage period. The cost of production of CO-1oyster mushroom gravy (250 g) was Rs.63. It was concluded that the retort processed CO-1oyster mushroom gravy can be safely stored up to 180 days at ambient temperature.

Key words: F0 value, Retort processed, Ambient, Sensory scores

Retorting is a method of preserving food by heating it in hermetically sealed containers for a specific duration at particular temperature to eliminate pathogenic microorganisms. Retort processing enables to providing ready to eat processed food products which are stable at ambient temperature (Bindu *et al*. 2010). Retort pouch processing technology has been widely recognized as one of the alternatives to metal cans for producing thermally processed shelf stable foods (Sabapathy *et al*. 2001). Retort pouches are constructed as four-ply laminates of different packaging films that can with stand high process temperature and pressure. The typical retortable pouches consist of 12 µm polyester, 15µm nylon, 9 µm aluminium foils, 80 µm cast-polypropylene Outer polyester (polyethylene terephthalate) layer is for heat resistance and printability, an aluminium foil layer as a barrier for oxygen and light, biaxial oriented nylon for resilience, and an inner layer of cast poly propylene for pack sealing.

Mushrooms are becoming a popular food in daily meal because of their nutritious and medicinal values. Edible mushrooms contain high amount of proteins, and are excellent source of fibers, vitamins and minerals (Manjunathan *et al*. 2011). Mushroom is a perishable food. Proper packaging minimizes deterioration and waste, extends the shelf life of the product. In order to preserve their quality, these products must be quickly processed and packed using retort packaging method. Retort (thermal) processing is intended to kill microorganism in food products to extend the shelf stability of the product, by the application of extreme heat condition 121.1°C (Kumar *et al*. 2013). In keeping the above points in present study, attempt was made to develop retort processed CO-1 oyster mushroom *gravy*.

MATERIALS AND METHODS

Raw materials

CO-1 oyster mushroom (*Pleurotus citrinopileatus*) varieties were purchased from mushroom farm in Madurai Preparation of CO-1 oyster mushroom gravy. Mushroom products was prepared using tomato, onion, green chillies, ginger, garlic, spices (cinnamon, cumin, fennel seeds, anise seed, and coriander), dry chillies, pepper powder, turmeric

powder cloves, salt, oil were purchased from local departmental stores.

Formulation of oyster mushroom gravy

Table 1 Composition of the standardized mushroom *gravy*

Ingredients	Quantity
Mushroom	100 g
Refined Oil	5.0 ml
Cinnamon	1.0 g
Onion	50 g
Garlic , ginger	7.0g
Tomato	60 g
Coriander powder	2.0 g
Chilli powder	2.0 g
Pepper	0.5 g
Anise	1.0 g
Cumin	0.25 g
Turmeric powder	0.1 g
Water	50 ml
Salt	5.0 g

The ingredients used for the masala preparations are given in (Table 1). Mushroom, onion, tomato, ginger garlic paste, cinnamon, cumin powder, coriander powder, anise powder, turmeric powder, chilli powder, pepper, oil salt ingredients were used to formulate the mushroom *gravy*.

Thermal processing of CO-1 oyster mushroom gravy

The pilot-scale horizontal stationary retorting system (Lakshmi engineering, Chennai, India) available in Community Science College and Research Institute, Tamil Nadu Agricultural University, Madurai, India was used for thermal retort processing. Filling exactly 250 g of the product, the head space air was entrapped manually out before sealing the top of the pouch hermetically by an impulse heat sealer. A semi-automatic heat sealing machine (Lakshmi engineering, Chennai, India) was used for the sealing of pouches. This sealing machine was maintained at 4 bar pressure for 6 s for sealing of each pouch.

The sealed pouches were immediately transferred to retort trays. The probes used for the experiments were copper/cupronickel thermocouples of stainless steel electrode with a length of 50 mm and dia of 1.2 cm. One pouch were inserted with a thermocouple for obtaining the heat penetration data. For sterilization, the retort temperature was maintained as par trial. Over pressure was maintained at 15 ± 1 psi throughout the process, using steam- air mixture. Process lethality in terms of f_0 value was measured from the temperature and time history.

Rapid cooling was accomplished by re-circulating cooling water at 27°C into the retort to bring down the retort and pouch temperature. When the core temperature had reached 60 - 50°C, water was drained out and retort door was opened. Pouches were inspected for any delamination and other visual defects. All the pouches were transferred to a tray containing tap water and held for 30 min to cool them further to room temperature to prevent the possibility of any thermophillic growth. The cooled pouches were then removed from water trays and wiped dry with the help of a clean, dry cloth.

Fig 1 Retort processed CO-1 oyster mushroom *gravy*

Biochemical analysis of CO-1 oyster mushroom gravy

The chemical constituents such as moisture contents of the sample were determined by the AOAC (1995). The pH of the sample was estimated by the method described by hart and Fisher 1971. Acidity of the sample was estimated by the method described by Ranganna (1995). Protein was analyzed by the amount of nitrogen available in the sample by Micro kjeldhal method by Ranganna (1995). Crude fiber content by Maynard (1970). Ash by Hart and Fisher (1971). Fat contents were determined by extraction with petroleum ether for 2 hours using a Soxhlet apparatus Cohen (1917). Peroxide value was determined as per the method described by Ranganna (1995). Free fatty acid content of the sample was estimated by the method described by Ranganna (1995).

Sensory evaluation

Organoleptic characteristics were determined on a evaluation by 15 semi trained panellists using 9-point hedonic scale as appearance, colour, flavour, texture, taste and overall acceptability (Pal *et al.* 1996).

Statistical analysis

Data from all experiments were performed in triplicate for each sample. The results of the three replicates were

pooled and expressed as mean ± standard deviation. Analysis of variance (ANOVA) was used to compare fresh and retort processed CO-1 oyster mushroom gravy by using factorial completely randomized design method as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Thermal processing

The retort pouches in the present study were processed to a F_0 value of 10.2 min and it was as per the recommended F_0 value for mushroom *gravy*. As per the sterility test and microbiological characteristics test conducted, the results indicated that the retort pouches received sufficient thermal processing temperature to achieve commercial sterility. The retort temperature and the product core temperature before processing was 35°C, 30°C and reached its first lethality rate, when the core temperature was 110°C and the retort temperature was 121.1°C (Fig 4). After 25 mins the core temperature of the product was 121°C. Cooling time was 10 min after attaining necessary product core temperature of 121°C. After cooling, the retort temperature was 35°C and the product core temperature was 60°C. Process time of the mushroom *gravy* was 25 minutes (Fig 2).

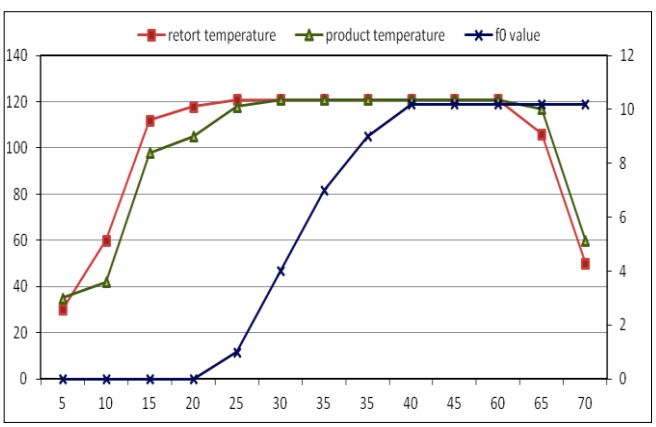

Fig 2 Thermal value of retort processed CO-1 oyster mushroom gravy

Effect of retort processed mushroom gravy

Effect of retort processed CO-1 oyster mushroom gravy given in (Table 2). The changes in moisture content of CO-1 oyster mushroom *gravy* before and after processing was decreased from 83.04 to 80.62. Rajkuma *et al*. (2010) reported a decrease in moisture content after retort processing of chettinad goat meat curry 73.19 to 66.47 per cent. The changes in pH value of CO-1 oyster mushroom *gravy* before and after processing increased from 6.08 to 6.48. Rajkuma *et al*. (2010) reported after retort processing there was a increased the pH value of 6.34 to 6.66 of chettinad goat meat product curry. Acidity of CO-1 oyster mushroom *gravy* decreased from 0.08 to 0.05 after retort pouch processing. The retort processing increases the pH content correspondingly decreases the acidity value.

In CO-1 oyster mushroom *gravy* before and after processing protein content increased from 6.69 to 7.13. Rajkuma *et al*. (2010) shows that protein content of chettinad goat meat curry increased after processing from 20.64 to 22.72 per cent. Retort processing reduced the moisture content leads to the increase in the protein value of mushroom *gravy*. The change in fibre content of CO-1 oyster mushroom gravy before and after processing was found to be 5.74 to 5.91. Similarly before and after retort processing increased the crude fibre value of (2.55 to 2.76 %) foxtail Millet *Halwa* (Kumar *et al*. 2017). The change in fat content of CO-1 oyster mushroom *gravy* before and after processing was calculated 4.41 to 6.73 g/100g respectively. (Kumar *et al*. 2017) reported that Foxtail Millet *Halwa* before and after retort processing fat value increased from 2.69 to 2.75 after retorting. Ash content of CO-1 oyster mushroom *gravy* was increased from 2.36 to 2.38 % respectively. Rajkumar *et al*. (2010) reported that chettinad goat meat curry has increased ash contents of the sample from 1.61 - 2.12% after retort processing. The change in before and after processing of CO-1 oyster mushroom *gravy* peroxide contents was increased from 2.03 to 2.4 m.eq. of O_2/kg fat. Kumar *et al*. (2017) reported that peroxide value of the retorted sample has also increased, indicating that the peroxides have formed in the unsaturated linkages of the fat due to high temperature processing.

Table 2 Effect of retort processed mushroom *gravy*

Chemical parameters	Before processing	After processing
Moisture (%)	83.4±3.56	80.62±2.38
pH	6.08±0.22	6.48±0.05
Acidity (%)	0.08±0.003	0.05±0.002
Protein (g/100g)	6.69±0.18	7.13±0.025
Fibre (g/100g)	5.74±0.22	5.91±0.197
Fat (g/100g)	4.41±0.151	6.73±0.218
Ash (%)	2.36±0.04	2.38±0.100
Peroxide value (m.eq. of O_2/kg fat)	2.03±0.08	2.4±0.090

Data indicate analyses of triplicates mean ± standard deviation

Changes in chemical characteristics of retort processed CO-1 mushroom gravy during storage

The results showed that the moisture content of RTE mushroom products was decreased during storage period. The initial and final moisture content of RTE mushroom *gravy* 80.62 to 79.84. Similarly, Rajkumar *et al*. (2010) reported that the *chettinad goat meat product* moisture content decreased range from 66.47 to 65.47 during storage period of 10 months. Kumar (2007) study reported a low water vapour transmission is an indicator of suitability of the pouches for retort processing. It is also positive for the shelf-life of the product. The packaging system based on aluminium foil has been reported to provide barrier against mass transfer, light and micro-organism and thus the moisture content of the product was almost retained till the completion of storage studies.

pH

The initial and final pH content of RTE CO-1 mushroom *gravy* ranged from 6.48 to 6.17. The statistical analysis of data showed a significant change were Observed during storage periods of mushroom *gravy*. Similar results have been reported by Rajan *et al*. (2014) in cheittinad chicken prepared from spent chicken and from broiler meat decrease pH content ranged from 52.8 to 49.6 during storage period of 180 days.

Table 3 Changes in chemical characteristics of RTE CO-1 mushroom gravy during storage

Chemical composition	Storage days						
	0 day	30 days	60 days	90 days	120 days	150 days	180 days
Moisture(g/100g)	80.62	80.51	80.43	80.29	80.10	79.95	79.84
pH	6.48	6.42	6.38	6.31	6.27	6.21	6.17
Acidity	0.05	0.05	0.06	0.07	0.07	0.08	0.09
Protein (g/100g)	7.13	7.11	7.09	7.08	7.06	7.04	7.01
Fat (g/100g)	6.73	6.75	6.78	6.81	6.82	6.83	6.84
Peroxide value (m.eq. of O_2/kg fat)	2.4	2.52	2.67	2.82	3.03	3.25	3.41
Free fatty acid (%)	0.41	0.74	1.01	1.35	1.64	1.92	2.26

Acidity

The initial and final acidity content of RTE mushroom *gravy* during storage ranged from 0.05 to 0.09 percent, respectively. Statistical analysis of the data revealed that a significant difference in acidity content increased during the storage period of mushroom *gravy*. Rajkumar *et al*. (2010) studied the changes in acid values of cheittinad chicken increased from 0.6 to 1.2 percent throughout the storage period.

Protein

The protein content of mushroom *gravy* during storage was decreased from 7.13 to 7.01 g /100g. There was no significant change during storage in mushroom *gravy*. Similar results were obtained by Dhanapal *et al*. (2010) studied the tilapia sandwich paste in retort pouch there was no significant change was observed in the content of protein ranged from 10.16 to 9.97 percent during storage period.

Fat

The initial and final fat content of RTE CO -1 oyster mushroom *gravy* ranged from 6.73 to 6.84 during storage period of six months. Similarly, Abhishek *et al*. (2014) investigated ready to eat soya peas curry stored under room temperature the fat content ranged from 23.12 to 23.24. No significant change was observed during storage. The packaging system based on aluminium foil has been reported to provide barrier against mass transfer, light and micro-organism. Nutritive value of the product was almost retained till the completion of storage studies.

Peroxide value (m.eq. of O_2/kg fat)

A slight increase in the peroxide content was observed in CO-1 oyster mushroom gravy. The initial and final peroxide content of RTE CO-1 mushroom *gravy* ranged from 2.4 to 3.41 m.eq. of O_2/kg fat, respectively. Shihab *et al*. (2013) found a slight increase in the peroxide value of retort processed samples when stored under room conditions. The lipid oxidation was attributed to the combination of free radicals with oxygen and to form hydroperoxides (Abhishek *et al*. 2014).

Changes in free fatty acid (%) content of mushroom products during storage

The results showed that the free fatty acid content of RTE CO-1 mushroom gravy was slightly increased during storage period. The initial and final free fatty acid content of RTE mushroom *gravy* ranged from 0.41 to 2.26 percent. Similarly, Abhishek *et al*. (2014) study showed a free fatty acids (FFA) content of soya peas curry increased from 0.9 to 2.6 under ambient temperature (27-30°C) storage.

Changes in microbial load of mushroom products during storage

Microbial load plays a very important role in determination of the length of storage till which the product remains consumable. The changes in the microbial population was observed periodically once in a 15 days during the storage period. In the processed RTE co-1 oyster mushroom gravy analysis total bacterial counts, yeast and mould could not be detected during the entire storage period of 6 months. Manju *et al*. (2004) also observed that seer fish curry packed in retort pouch remained sterile throughout storage period of 19 months. Rajkumar *et al*. (2010) reported that *coliforms, clostridium botulinum, staphylococcus*, yeast and mould were absent in retort processed chettinad goat meat during storage up to 10 months.

Changes in organoleptic characteristics of mushroom gravy during storage

The change in the quality attributes directly influence the organoleptic scores. As the storage period progress there was a slight change in the colour and appearance and flavour, texture which in turn affected the taste of the product. Similarly reported by Devadason *et al*. (2014) in retort processed buffalo meat block during room temperature storage of 135 days decreased the overall acceptability of the product. This might be also due to slight

degradation of proteins and oxidative changes in the product affect the overall acceptability of the products.

The production cost of the developed retort processed RTE CO -1 oyster mushroom products such as mushroom *gravy* was comparatively lesser than the market price. The final unit cost of mushroom *gravy* was ₹ 63/250 g. Thus it is concluded that retort processed mushroom products could be stored for 6 months successfully. These products will have increasing consumer demand in future because there is increased need for ready to eat food products in both developed and developing countries.

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LITERATURE CITED

Abhishek V, Kumar R, George J, Nataraju S, Lakshmana J H, Kathiravan, Madhukar N. 2014. Development of retort process for ready-to-eat (RTE) soy-peas curry as a meat alternative in multilayer flexible retort pouches. *International Food Research Journal* **21**(4).

AOAC. 2013. Air drying and osmotic dehydration of oyster mushroom and development of mushroom based product. Submitted in Department of Food Technology and Rural Industries. Bangladesh Agricultural University, Mymensingh.

Bindu J, Ravishankar C N, Srinivasa Gopal T K and Mallick A K. 2010. Investigation of shelf life and heat penetration attributes of ready-to-eat "fish peera" from anchovy (*Stolephorous commersoni*) in retort pouches. *Journal of Food Processing and Preservation* **34**(S1): 207-222.

Cohen E H. 1917. Association of Official Analytical Chemists. **54**: 212.

Devadason I P, Anjaneyulu A S R, Mendirtta S K and Murthy T R K. 2014a. Quality and shelf life of buffalo meat blocks processed in retort pouches. *Journal of Food Science and Technology* **51**(12): 3991-3997.

Dhanapal K, Reddy G V S, Nayak B B, Basu S, Shashidhar K, Venkateshwarlu G and Chouksey M K. 2010. Quality of ready to serve tilapia fish curry with PUFA in retortable pouches. *Journal of Food Science* **75**(7).

Gomez K H and Gomez A A. 1984. *Statistical Procedures for Agricultural Research* (2nd Edition). John Wiley and Sons. *In*: (Eds) Oser B. K., 14th Edition. pp 1094.

Hart A M and Fisher H. 1971. Modern food analysis. Springervarley, Belrin, Heidelberry, New York. pp 64-74.

Kumar R, Harish S, Subramanian V, Sunny Kumar S and Nadanasabapathi S. 2017. Development and quality evaluation of retort processed RTE functional gluten free foxtail millet halwa. *Croatian Journal of Food Science and Technology* **9**(2): 114-121.

Kumar R, Johnsy G, Rajamanickam R, Lakshmana J H, Kathiravan T, Nataraju S and Nadanasabapathi S. 2013. Effect of gamma irradiation and retort processing on microbial, chemical and sensory quality of ready-to-eat (RTE) chicken pulav. *International Food Research Journal* **20**(4).

Kumari M, Urooj A and Prasad N N. 2007. Effect of storage on resistant starch and amylose content of cereal–pulse based ready-to-eat commercial products. *Food Chemistry* **102**(4): 1425-1430.

Manju S, Sonaji E R, Leema J, Srinivasa Gopal T K, Ravishankar C N and Vijayan P K. 2004. Heat penetration characteristics and shelf life studies of seer fish moilee packed in retort pouch.

Manjunathan J and Kaviyarasan V. 2011. Nutrient composition in wild and cultivated edible mushroom, *Lentinus tuberregium* (Fr.) Tamil Nadu, India. *International Food Research Journal* **18**(2): 809-811.

Maynard A J. 1976. *Methods in Food Analysis*. Academic Press, New York. pp 176.

Pal U K and Agnihotri M K. 1996. Effect of vegetable oil on the quality of fresh chevon sausages. *Journal of Applanim Research* **9**: 187-191.

Rajan S, Kulkarni V V and Chandirasekaran V. 2014. Preparation and storage stability of retort processed Chettinad chicken. *Journal of Food Science and Technology* **51**(1): 173-177.

Rajkumar V, Dushyanthan K and Das A K. 2010. Retort pouch processing of Chettinad style goat meat curry—a heritage meat product. *Journal of Food Science and Technology* **47**(4): 372-379.

Ranganna S. 1995. *Manual Analysis of Fruits and Vegetable Products*. 2nd Edition. Tata Mc-Graw Hill Pulishing Co. Ltd., New Delhi.

Sabapathy S N, Ramakrishna A and Srivastava A N. 2001. Current status and potential for retort processed foods in India. *Indian Food Industry* **20**(3): 78-79.

Shihab M C P, Hafeeda P, Kumar R, Kathiravan T and Nadanasabapathi S. 2013. Development and evaluation of shelf stable retort processed ready-to-drink (RTD) traditional Thari Kanchi payasam in flexible retort pouches. *International Food Research Journal* **20**(4).

Terajima Y and Nonaka Y. 1996. Retort temperature profile for optimum quality during conduction-heating of foods in retortable pouches. *Journal of Food Science* **61**(4): 673-678.