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LOW COST PRESERVATION OF CAULIFLOWER FOR 180 DAYS THROUGH HURDLE TECHNOLOGY

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ABSTRACT

Cauliflower blanched at (100°C for 60 sec.), then steeped into different concentrations of preservatives– P0(Control-fresh), P1(8% Salt+500 ppm Potassium metabisulphite+100 ppm Sodium benzoate), P2(10% Salt+400 ppm Potassium metabisulphite+200 ppm Sodium benzoate), P3(12% Salt+300 ppm Potassium metabisulphite+300 ppm Sodium benzoate), P4(8% Salt+0.3%Citric acid+300 ppm Potassium metabisulphite+300 ppm Sodium benzoate), P5(10% Salt+0.2% Citric acid+400 ppm Potassium metabisulphite +200 ppm Sodium benzoate) and P6(12% Salt+0.1% Citric acid+500 ppm Potassium metabisulphite+100 ppm Sodium benzoate). Then aseptically packed into food grade polyethylene pouches & stored at T1 (30-37°C) & T2 (5-7°C) for a storage period of 180 days. Treatments which remained microbial safe till 180 days are P4/T1, P4/T2 & P5/T2. Among these three, P4/T2 was scored lowest in physical & highest in sensory evaluation & cost of preservation of P4/T1 was lowest. So best hurdle treatment for preservation of cauliflower for 180 days was P4/T2 & cheapest treatment was P4/T1.

KEYWORDS: Cauliflower, Hurdle, Blanched, ppm.

INTRODUCTION

India is a leading vegetable producing country in the world with the production of 113.5 million tons. The country is blessed with the unique gift of nature of diverse climates and distinct seasons, which makes it possible to grow a variety of vegetables. The overall productivity of vegetables is 14.4 tons per hectare. The production of vegetables has taken a big jump due to advent of many hybrid varieties. But our market strategy is not equipped with the handling of large quantity of vegetables as a result quantities of vegetables get spoil. Post harvest losses of horticulture crops are immense. It varies between 5-39% of the total production. The shelf life of perishable vegetables is very low. In brinjal, cauliflower and chilly post harvest losses were found to be high (Jayanthi, 2005).

Preservation involves action taken to maintain foods with desired properties or nature for as long as possible. It lies at the heart of Food Science & Technology & it is the main purpose of Food Processing (Barnettand & Blanchfield, 1995). The Hurdle concept was first to be introduced by (Lothar Leistner of Germany & his colleagues, 1978). The hurdle governs many preservation processes.

Intense heat (F) preserves canned foods, low water activity prevents microbial growth in dried products, low pH is responsible for prolonged shelf life of fermented foods. This preservation technique is also called combination techniques or barrier technology or *metodascombinados* in Spanish, *technologia degli ostacoli* in Italian, *Hurdle Technology* in German. Potential hurdles for food preservation are – Temperature (High or Low), pH (High or Low), Water activity (High or Low), Modified atmosphere (Co_2, N_2 etc), Packaging (Vacuum packaging, aseptic packaging, edible coating etc.), Radiation (UV, microwave, irradiation etc), Preservatives (Class I & II). Hurdle Technology is a technology by which 2 or more hurdles are employed in a suitable combination and every hurdle is used at an optimum level so that damage to the overall quality of food is kept to the minimum. Hurdle Technology foods are defined as "Products whose shelf-life and the microbial safety are extended by use of several factors none of

which individually would be totally lethal towards spoilage or pathogenic microbes" (Barwal, 1994).

RESEARCH OBJECTIVES ARE

- To develop a suitable hurdle technology (appropriate concentration & combinations of preservatives, storage temperatures & storage periods) for preservation of cauliflower for 180 days.
- To study the effect of hurdle technology (different concentration & combinations of preservatives, storage temperatures & storage periods) on the microbial content of preserved cauliflower.
- To study the effect of hurdle technology (different concentration & combinations of preservatives, storage temperatures & storage periods) on the physical & sensory properties of preserved cauliflower.
- To estimate the cost of preservation of cauliflower for 180 days by hurdle technology.

MATERIAL & METHODS

Cauliflower cords: The cords of cauliflower were procured from local market of Naini.

Chemicals used in preservation: Food grade (potassium metabisulphate, sodium benzoate & citric acid) chemicals were used.

Polyethylene pouches: Food grade pouches were used.

Reagents used in analysis: Analytical grade reagents were used.

Method of preservation: First cauliflower head (white curds) after sorting, were cut into 5×3×3 cm. pieces with sharp edged stainless steel knife, then thoroughly washed in tap water and distilled water. After washing blanched at 100°C for 60sec. then steeped into different concentrations & combinations of preservatives – P0 (Control sample- fresh without treatment), P1(8% Salt + 500 ppm Potassium metabisulphite + 100 ppm Sodium benzoate), P2 (10% Salt + 400 ppm Potassium metabisulphite + 200 ppm Sodium benzoate), P3(12% Salt + 300 ppm Potassium metabisulphite + 300 ppm Sodium benzoate), P4 (8% Salt + 0.3% Citric acid + 300 ppm Potassium metabisulphite + 300 ppm Sodium benzoate), P5 (10% Salt + 0.2% Citric acid + 400 ppm Potassium metabisulphite + 200 ppm Sodium benzoate) and P6 (12% Salt + 0.1% Citric acid + 500 ppm Potassium metabisulphite + 100 ppm Sodium benzoate). Then aseptically packed into food grade polyethylene pouches and stored at two different level of temperatures- T1 (ambient temperature – 30 to 37 °C) & T2 (refrigeration temperatures – 5 to 7 °C) for different time intervals i.e. 0, 30, 60, 90, 120, 150 & 180 days respectively. These preserved cauliflowers were studied for their microbial, physical, sensory, & total cost of preservation. Data obtained after analysis were statistically analyzed.

METHODS OF ANALYSIS

Microbial properties: Yeast & mold was determined by Conventional method, (Ranganna, 2005).

Physical properties: Water activity was determined by using Water Activity Meter (Opearators Mannual AQUA LAB SERIES 4TE, 2007). pH was determined by using pH meter (Electronic Corporation of India, Model 5652) as per procedure described in (Ministry of Health & Family Welfare, 2005).

Sensory properties: Sensory properties (color, flavor, texture & overall acceptability) were determined by 9 Point Hedonic Scale method (Ranganna, 2005).

Cost of preservation: Cost analysis performed for those combinations of preservatives which was successfully preserved for 180 days. For this, add the cost of all the material (cauliflower, chemicals, polythene pouches, energy etc.) used during preservation.

Statistical analysis: Obtained data were analyzed for ANOVA (3 Way Classification) & critical difference (C.D.) technique, described by (Imran and Coover, 1983). In statistical analysis, data used were average of replicates, total no. of treatments combinations were 14 – P0/T1, P0/T2, P1/T1, P1/T2, P2/T1, P2/T2, P3/T1, P3/T2, P4/T1, P4/T2, P5/T1, P5/T2, P6/T1, P6/T2 (where P0, P1, P2, P3, P4, P5 & P6 are different combination o28f preservatives and T1 & T2 are different level of temperatures, all are explained in Method of preservation). Level of significance was checked at 5% probability level.

RESULTS

Microbial properties of preserved cauliflower: Scores of Yeast & mold count of preserved cauliflower are given in Table 1. Treatments in which mean of yeast & mold count were found lowest with a storage period of 180 days are P4/T1, P4/T2 & P5/T2. There were significant difference between yeast & mold count of treated samples due to combination of preservatives & storage temperatures while there was no significant difference due to days of storage at 5% probability levels.

Physical properties of preserved cauliflower: Scores of water activity & pH of preserved cauliflower are given in Table 1. Lowest water activity & lowest pH were found in P4/T2 in a storage period of 180 days. There were significant difference between water activity scores of treated samples due to combination of preservatives & storage temperatures while there was no significant difference due to days of storage at 5% probability levels. Same condition found with scores of pH also.

Table-1 – Scores of Yeast & mold count, Water activity & pH of preserved cauliflower in different treatments with its shelf life Treatments with its YMC/gm Water activity (%) pH Shelf life (in days)

Table 1. – Scores of Yeast & mold count, Water activity & pH of preserved cauliflower in different treatments with shelf life

Treatments with its Shelf life(in days)	YMC/gm	Water activity (%)	pH
P0/T1 -180	32.17*	0.98*	6.2*
P0/T2 -180	32.17*	0.98*	6.2*
P1/T1 - 30	65	0.78	4.5
P1/T2 - 60	51	0.74	4.2
P2/T1 - 60	5.75	0.71	4.4
P2/T2 - 90	6.8*	0.69*	4.14
P3/T1 - 90	52	0.76	4.2
P3/T2 -120	47.5	0.74	4.0
P4/T1 -180	23.14*	0.67*	3.5*
P4/T2 -180	8.43*	0.63*	3.3*
P5/T1 -150	40.29	0.74	3.9
P5/T2 -180	17.71*	0.66*	3.7*
P6/T1-120	28.45*	0.69*	4.04
P6/T2 -150	26.5*	0.67*	3.8

YMC/gm-Yeast & mold count/gm; All values are MEAN; *Significant values

Table 2 – Scores of sensory evaluation of preserved cauliflower in different treatments with its shelf life

Treatments with its Shelf life(in days)	Colour and Apperance	Flavour and Taste	Body and texture	Overall acceptability
P0/T1 -180	9*	9*	9*	9*
P0/T2 -180	9*	9*	9*	9*
P1/T1 - 30	7	7.3*	7	7
P1/T2 - 60	6.66	7.8*	7.2*	7
P2/T1 - 60	6	6.66	6.66	6
P2/T2 - 90	6	6.75	7	6.25
P3/T1 - 90	6.25	7	6.75	6.25
P3/T2 -120	6.6	7.4*	6.8	6.8
P4/T1 -180	7.14*	7.43*	7.28*	7.14*
P4/T2 -180	8*	8.2*	8.14*	8*
P5/T1 -150	7	7.16*	7.16*	7
P5/T2 -180	7.71*	8.14*	7.42*	7.85*
P6/T1-120	6	6.8	6.6	6.6
P6/T2 -150	7.16*	7.5*	7	7.3*

All values ar mean; *significant value

Table 3 - Cost analysis of preserved cauliflower through Treatment P4 / T1

S. No.	Ingredients	Rate(Rs.)	Quantity used	Amount (Rs.)
1.	Cauliflower	8Rs./Curd	6	48.00
2.	Salt	12Rs./Kg	8% (240gm)	2.88
3.	Citric acid	204Rs./500gm	0.3% (9gm)	3.7
4.	Potassium metabisulphite	280Rs./500gm	300ppm (0.9gm)	0.50
5.	Sodium benzoate	289Rs./500gm	300ppm (0.9gm)	0.52
6.	Plastic pouches	15Rs./100pieces	6pieces	0.90
Cost of 6 pouches (3 kg cauliflower)				56.5
Cost of 1 pouch (500 gm cauliflower)				9.42

Table 4 - Cost analysis of preserved cauliflower through Treatment P4 / T2

S. No.	Ingredients	Rate (Rs.)	Quantity used	Amount (Rs.)
1.	Cauliflower	8Rs./Curd	6	48.00
2.	Salt	12Rs./Kg	8% (240gm)	2.88
3.	Citric acid	204Rs./500gm	0.3% (9gm)	3.7
4.	Potassium metabisulphite	280Rs./500gm	300ppm (0.9gm)	0.50
5.	Sodium benzoate	289Rs./500gm	300ppm (0.9gm)	0.52
6.	Plastic pouches	15Rs./100pieces	6pieces	0.90
7.	Electric charge	4/unit	234	936
Cost of 6 pouches (3 kg cauliflower)				992.5
Cost of 1 pouch (500 gm cauliflower)				165.42

Table 5 - Cost analysis of preserved cauliflower through Treatment P5 / T2

S. No.	Ingredients	Rate (Rs.)	Quantity used	Amount (Rs.)
1.	Cauliflower	8Rs./Curd	6	48.00
2.	Salt	12Rs./Kg	10% (300gm)	3.6
3.	Citric acid	204Rs./500gm	0.2% (6gm)	2.45
4.	Potassium metabisulphite	280Rs./500gm	400ppm (1.2gm)	0.67
5.	Sodium benzoate	289Rs./500gm	200ppm (0.6gm)	0.35
6.	Plastic pouches	15Rs./100pieces	6 pieces	0.90
7.	Electric charge	4/unit	234	936
Cost of 6 pouches (3 kg cauliflower)				991.97
Cost of 1 pouch (500 gm cauliflower)				165.33

Cost analysis of preserved cauliflower: As cost analysis performed only for those combinations of treatments which were successfully preserved for 180 days (i.e. P4/T1, P4/T2 & P5/T2) through Hurdle Technology. Cost analysis of treatments P4/T1, P4/T2 & P5/T2 are presented in Table 3, 4 & 5 respectively. Cost of preservation through treatment P4/T1 was only Rs. 56.5/3kg of cauliflower which was much cheaper than P4/T2 (Rs.992.5/3kg) & P5/T2 (Rs.991.97/3kg).

DISCUSSION

In microbial analysis, the increase in yeast & mold count was observed in all treatments at both the temperatures. In most of the treatments yeast & mold count were found above from the standard (Food Safety & Standard Authority of India, 2006-Yeast/Mold count not more than 100 count/gm) with increase in storage period, which may be attributed during addition of preservatives or during packaging which could have been a carrier of microbes. While in some treatments yeast & mold counts remained under control as per above mentioned standard till 180 days of storage period, it might be due to better handling procedure or different concentration & combinations of class I & II preservatives & low temperature of storage. The results are in agreement of previous finding of (Gould, 1995), observed that the food preservation through hurdle technology cause interference with the homeostasis of yeast & mold. (Alzamora et al., 1989), also noticed that yeast and mould counts remained below 100 cfu/gm during 4 months of storage of pineapple slices preserved through hurdle technology at 5°C. (Lopez- Malo et al., 1994), preserved papaya through hurdles technology, found yeast & mold counts < 10 CFU/g during 5 months storage at 25°C.

In physical test, the reduction in water activity & pH of preserved sample were found as compare to initial or fresh commodity. Reduced water activity & pH were found effective for long time storage. The results are in agreement of previous finding of (Vibhakara et al., 2005), maintenance of pH< 4.5 helped in controlling multiplication and survival of spores & also helpful in achieving shelf stability. Low pH

and water activity solutions are used as antimicrobial agent or as antioxidant to prevent browning, to reduce discoloration of pigments, and to protect against loss of flavor, changes in texture (Wiley, 1994).

In sensory evaluation, the difference & decrease in sensory scores was observed which may be attributed due to increase in microbial count with increase in storage period. But at the same time, treatments which remained microbial safe till 180 days of storage period were best rated in sensory evaluation (color & appearance, flavour & taste, body & texture & overall acceptability). The results are in agreement of previous finding of (Pruthi, 1990), the vegetables like potatoes, carrot, cauliflower, cabbage, bitter guard, peas, mushroom and animals foods (meat, fish and poultry) preserved in an acidified sulphited brine solution through steeping can be used for pickling or home cooking after leaching out the salt and acid. (Barwal et al., 2005) standardized the low cost and low energy processing technology for preservation of cauliflower involving different concentration and combination of salt (5-10%), potassium metabisulphite (0.2%) and citric acid (1%) after blanching. The preserved cauliflower was accepted in sensory evaluation after 90 and 180 days of storage by reconstituted in running water for half an hour & evaluated for the preparation of pickle and pakora.

In cost analysis, preservation of cauliflower performed at low temperature (T2- 5-7°C), was cheaper then preservation at high temperature (T1-30-37°C).

CONCLUSION

All the treatments combination was not effective for preservation of cauliflower till 180 days of storage period. Only 3 treatments - P4/T1, P4/T2 & P5/T2 were microbial safe till 180 days & among these 3, treatment P4/T2 was found best in physical & sensory but cost of preservation through treatment P4/T1 for 180 days of storage period was found cheapest. So best hurdle treatment for low cost preservation of cauliflower for 180 days was P4/T1.

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