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MICROBIAL, SENSORY AND NUTRITIONAL PROPERTIES OF CAULIFLOWER, PRESERVED BY HURDLE TECHNOLOGY

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ABSTRACT

Objective: Develop suitable Hurdle treatment for preservation of cauliflower till 180 days of storage period. **Methods:** Fresh cauliflower were preserved by combinations of hurdles i.e. blanching (100°C for 60 sec.), 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), aseptically temperatures **T1** (ambient- 30-37 °C) & **T2** (refrigeration- 5-7 °C) for different time intervals i.e. 0, 30, 60, 90, 120, 150 & 180 days respectively. This preserved cauliflower were studied for their microbial, sensory & nutritional properties.

Results: The treatments which remained microbial safe till 180 days of storage period were P4/T1 (YMC- 23.14count/gm), P5/T2(YMC- 17.71count/gm) & P4/packed into food grade polyethylene pouches and then stored at two different T2 (YMC - 8.43count/gm). Among these three, P4/T2 was scored highest in sensory, lowest in physical and highest in nutritional evaluation. **Conclusion:** Best hurdle treatment for preservation of cauliflower till 180 days of storage period was P4/T2.

Keyword: Hurdle **,** YMC, 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 ([9]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 ([3]Barnettand & Blanchfield, 1995). The Hurdle concept was first introduced by Prof. [10]Lothar Leistner of Germany & his colleagues in 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" ([5]Berwal, 1994).

Justification for research objective –

1) Through hurdle technology it become easy to preserve cauliflower at house hold level.
2) Make available the cauliflower at house hold level in off season.
3) Cauliflower preserved through hurdle technology are free from hazardous chemical which are used in cold storage to keep it like a fresh commodity.

Purpose – To preserve cauliflower through hurdle technology till 180 days.

MATERIAL AND 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. This preserved cauliflower were studied for their microbial , sensory, physical & nutritional properties and data obtained after analysis were statistically analyzed.

Microbial properties: Yeast & mold was determined by Conventional method, ([14]Ranganna 2005).

Sensory properties : Sensory properties (color, flavor, texture & overall acceptability) were determined by 9 Point Hedonic Scale method ([17]Ranganna 2005).

Physical properties: Water activity was determined by using Water Activity Meter ([2]Aqua Lab Series 4TE- 2007). pH was determined by using pH meter (Electronic Corporation of India, Model 5652) as per procedure described in [12]Ministry of Health & Family Welfare, Manual of methods of analysis

of foods- Fruit and Vegetable Products , (2005)

Nutritional properties : Protein determined by Micro-Kjeldahl / Kjeltec method ([16]Ranganna, 2005), Vitamin A determined by method mentioned in ([18]Ranganna 2005), Vitamin C determined by 2, 6-dichlorophenol-indophenol visual titration method, ([19]Ranganna 2005) & potassium determined by Flame photometric method, ([15]Ranganna 2005).

Statistical analysis : Obtained data were analyzed for ANOVA (3 Way Classification) & critical difference (C.D.) technique, described by [8]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 of 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 : Yeast & mold count of preserved cauliflower are given in Table 1. Treatments in which 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 not significant difference due to days of storage at 5% probability levels.

Sensory properties of preserved cauliflower : In sensory properties, results of only overall acceptability parameter was presented in Table 1. Treatment P4/T2 scored highest in overall acceptability with a storage period of 180 days. There were significant difference between overall acceptability scores of treated samples due to combination of preservatives & days of storage while there was not significant difference due to storage temperatures at 5% probability levels.

Physical properties of preserved cauliflower : From Table 1 - lowest water activity & from Table 2 - lowest pH were found in P4/T2 in a storage period of 180 days. There were significant difference between water activity & pH scores of treated samples due to combination of preservatives & storage temperatures while there was not significant difference due to days of storage at 5% probability levels.

Nutritional properties of preserved cauliflower : From Table 2 - highest retention of protein & vitamin A and from Table 3 - highest retention of vitamin C & potassium were found in treatment P4/T2 in a storage period of 180 days. There were significant difference between protein, vitamin A, vitamin C & potassium scores of treated samples due to combination of preservatives , storage temperatures & days of storage at 5% probability levels..

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 (as per [6] Food Safety & Standard Authority of India, 2006-Yeast/Mold 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 counts remained under control as per above mentioned standard till 180 days of storage, 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 [7]Gould (1995), observed that the food preservation through hurdle technology cause interference with the homeostasis of yeast & mold. [1]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. [11]Lopez- Malo et al. (1994), preserved papaya through hurdles technology, found yeast & smold counts < 10 CFU/g during 5 months storage at 25°C.

In sensory evaluation, the difference & decrease in overall acceptability 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. The results are in agreement of previous finding of [13]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. [4]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 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 [21]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 ([23]Wiley, 1994).

In nutritional evaluation, loss of nutrients were found in each treatments but on other hand better retention of protein, vitamin A, vitamin C & potassium were also observed in treatments of 180 days of storage period. The results are in agreement of previous finding of [20]Srivastava & Kumar (2002), sulphur dioxide is widely used throughout the world in the preservation as it acts as an antioxidant and bleaching agent. These properties help in the retention of vitamin C, vitamin A and other oxidizable compounds. Sulphur dioxide with potassium metabisulphite (if added in the solution) helps to retain vitamin C content of the preserved material ([22]Verma & Joshi, 2000). Low pH and water activity solutions were also effective towards nutrient retention ([23]Wiley, 1994).

CONCLUSION

All the treatments combination were 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, only P4/T2 was found best in sensory as well in nutrient retention in 180 days of storage period.

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Table 1. – Yeast & mold count, Overall acceptability & Water activity scores of preserved cauliflower in different treatments with its shelf life

Treatments with its Shelf life(in days)	YMC/gm	Overall acceptability	Water activity(%)
P0/T1 -180	32.17*	9*	0.98*
P0/T2 -180	32.17*	9*	0.98*
P1/T1 - 30	65	7	0.78
P1/T2 -60	51	7	0.74
P2/T1 -60	35.75	6	0.71
P2/T2 -90	26.8*	6.25	0.69*
P3/T1 -90	52	6.25	0.76
P3/T2 -120	47.5	6.8	0.74
P4/T1 -180	23.14*	7.14*	0.67*
P4/T2 -180	8.43*	8*	0.63*
P5/T1 -150	40.29	7	0.74
P5/T2-180	17.71*	7.85*	0.66*
P6/T1-120	28.45*	6.6	0.69*
P6/T2 -150	26.5*	7.3*	0.67*

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

Table 2. – pH, Protein & Vitamin-A scores of preserved cauliflower in different treatments with its shelf life

Treatments with its shelf life (in Days)	pH	Protein (mg/100gm)	Vitamin-A (mg/100gm)
P0/T1 -180	6.2*	2.5*	50.23*
P0/T2 -180	6.2*	2.5*	50.23*
P1/T1 -30	4.5	2.1	49
P1/T2 -60	4.2	2.2	49.33
P2/T1 -60	4.4	2	48.4
P2/T2 -90	4.14	1.9	49.03
P3/T1 -90	4.2	1.72	47.5
P3/T2 -120	4.0	1.8*	48.2*
P4/T1 -180	3.5*	1.3*	45.2*
P4/T2 -180	3.3*	1.6*	47.2*
P5/T1 -150	3.9	1.5	43
P5/T2 -180	3.7*	1.4*	45.2*
P6/T1 -120	4.04	1.3	45
P6/T2 -150	3.8	1.82*	47*

All values are MEAN ; * Significant values

Table 3. – Vitamin -C & Potassium scores of preserved cauliflower in different treatments with its shelf life

Treatments with its shelf life (in Days)	Vitamin-C (mg/100gm)	Potassium (mg/100gm)
P0/T1 -180	55.56*	136.21*
P0/T2 -180	55.56*	136.21*
P1/T1 -30	49	134.5
P1/T2 -60	49.8	135.7
P2/T1 -60	49.5	132.2
P2/T2 -90	50.4*	135.5*
P3/T1 -90	46.6	131.9
P3/T2 -120	47*	135.11*
P4/T1 -180	33.5*	128.4*
P4/T2 -180	37.6*	132.1*
P5/T1 -150	35.2	128.2
P5/T2 -180	37.4*	130.8*
P6/T1 -120	37.7	130.2
P6/T2 -150	38*	133.2*

All values are MEAN ; *Significant values