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Physicochemical and Microbial Analysis of Minimally Processed Fruits and Vegetables

Manjula. K[1], Y. B. Bhagath[2], Soujanya. K[3]
Food technology, Dept. Of Home Science, Sri Venkateswara University, Tirupati-517502

***Abstract**: The aim of present study was to assess the physicochemical and microbiological quality of minimally processed fruits and vegetables available in the markets. Minimally processed fruits and vegetables, which are raw products that are simply trimmed, peeled ,sliced, shredded, washed and are disinfected ,are generally considered safe to be eaten by consumers, since their surface have micro organisms that are not of human health significance. Various chemical parameters like moisture, PH, acidity as well as microbial analysis like Total plate Count (TPC), Yeast and Moulds were analysed .From the results of the study, there was a significant decrease in the physicochemical parameters and significant increase in microbial load was observed in minimally processed fruits and vegetables during the storage periods.*

***Keywords:** Minimal processing, Fresh-cut produces, Total Plate Count, Yeast & Moulds.*

I. Introduction

Fresh fruits and vegetables are considered for the sign of novel health and good source of nutritional supplement for the human body. Due to important role of fruits and vegetables in human diet, increasing consumption of fresh horticulture produces for health benefits; there also have been significant changes in life style, modern kitchen activities, and changes in consumption trends. These changes have produced a demand for wide range of fresh produces, and have led people to spend less time to cook and to eat easily with fresh like quality. Such trends have been reflected an increase in popularity of minimally processed convenience foods that are ready to eat or ready to cook. By the view of above, consumption of fresh cut or minimally processed fruit and vegetables has marked a sharp increase [1]. The purpose of minimal processing is to deliver to the consumer a fresh like with an extended shelf life whilst ensuring food safety and maintaining better nutritional status and quality [2]. Generally a shelf life of about 7 days is required for domestic consumption and 7-15 days for overseas consumption [3]. During the storage periods of minimally processed fruits and vegetables, there are several obstacles were raised in physical, chemical properties and in microbial load which are directly proportional to the quality of processing operations such as washing, sorting, trimming, peeling, slicing, coring.etc[4]. Minimally processed foods are highly nutritious but highly perishable. Removing the skin from the surface or altering the size leads to the loss of nutrients, rupture of cells accelerate the enzymatic reactions, rapid microbial growth, colour changes, textural changes and weight loss results poor quality of the produce[5].

By reviewing all concerns regarding health and nutritional benefits of consumers there is a need in hygienically improved activities in processing and rapid techniques for minimal processing of fruits and vegetables. Packaging in Modified Atmosphere (MOP), together with refrigeration, slow down air flow and consequently the respiration of the vegetables [6]. Bacterial growth also inhibited and the shelf life of the product is enhanced. Advances in processing and conservation techniques together with better distribution and trading, have made nearly all kinds of fresh fruit and vegetables available with good quality. On the other hand some of the processing techniques and poor unit operations employed in minimal processing of fruits and vegetables have result negative impact by means of physical characteristic changes like colour, texture, appearance and chemical changes like PH, moisture content, acidity and microbial contamination [7]. Number of studies has assessed the microbiological conditions of ready to eat fruits and vegetables available in super markets, street markets, and grocery shops. Minimally processing results fresh and convenience products, but it reduces the shelf life. As a result maintenances of quality is a challenge to the rapidly growing minimal food processing sector [8]. To determine the physicochemical and microbiological safety of minimally processed pine apple and cabbage available in the chittoor district are randomly collected from the local markets was analysed. Further more changes in physicochemical parameters and microbial count were studied along the storage periods.

II. Materials And Methods

In present study minimally processed fruits and vegetables i.e., pine apple and cabbage were collected aseptically from local super markets in Tirupati town and immediately brought to the testing laboratory for further examination.

Market Survey and Sampling

A market surrey was carried out to know the availability and demand of various minimally processed fruits and vegetables. Based on the market survey, the most frequently used minimally processed pine apple and cabbage were selected for current study. The selected samples were collected aseptically in sterilized container maintained in cold conditions, immediately delivered to the laboratory within two hours, and analyzed.

Physicochemical Analysis:

Various physicochemical parameters like Moisture, PH, and Acidity were analyzed for both pine apple and cabbage. The moisture content was determined by indirect method [9] and the acidity was titrated using 0.1N NaOH using few drops of 1% phenolphthalein as indicator [10]. PH was noted by hand PH meter[Hanna instruments-PHep PH tester-code no:1212317]. All parameters were determined on various storage periods.

Microbial Analysis:

The selected samples of pine apple and cabbage were brought to the laboratory under aseptic conditions, Total Plate Count (TPC) and Yeast and Moulds count were performed [11]. All analyses were carried out in duplicate and average values were tabulated. Suitable media i.e., Nutrient Agar Media (NAM) and Potato Dextrose Agar (PDA) media were prepared for TPC as well as yeast and moulds [12]. Serial dilutions were employed to obtain pure cultures, for TPC and yeast& moulds 10^{-7} and 10^{-3} dilutions were taken [13]. From the dilutions 1 ml of the sample was taken for the culture along the duplicate ones. Culture dishes were incubated for 2 days at room temperature. The average number of colony forming units (CFU) from the duplicate plates of the dilutions was calculated [14].

Statistical Analysis:

The results obtained were tabulated and analysed using appropriate statistical techniques.

III. Results And Discussion

The physic chemical characteristics of pine apple and cabbage were analysed and tabulated. The data in table no.2 regarding moisture content shows that pine apple at 0,3rd,5th days were 85.87±0.06,85.36±0.40,84.57±0.25 respectively and mean values of cabbage at 0,3rd,5th days was 91.12±0.06,90.32±0.06,89.36±0.19 respectively. A significant decrease in moisture content was observed in both pine apple and cabbage during storage period's .It might be due to loss of water content from injured cells at the cut surface as well as during preparation of fresh cut produces. Brecht (1995)[15] carried out a study on "shelf life of fresh cut vegetables" also showed similar results that the moisture content of fresh cut vegetables was decreased on storage periods due to the reason that wounds inflicted during the preparation of fresh cut vegetables, removal of protective epidermal layers and exposure of cell portions to the open air gives rise in loss of moisture content from the cut surfaces [16].

Minimally processed fruits and vegetables	Moisture Mean ±SD			F-value	Sig
	0 day	3rd day	5th day		
Pine apple	85.87±0.06	85.36±0.4	84.57±0.28	15.67	0.004*
Cabbage	91.12±0.06	90.32±0.06	89.36±0.19	145.103	0.000*

Table No: 2 Moisture content of minimally processed pine apple and cabbage during shelf life.

The data from table no.3, the mean values of PH of minimally processed pine apple at 0, 3rd, 5th days were3.48±0.03, 3.20±0.00, 3.00±0.00 and mean values for cabbage at 0, 3rd, 5th day was 6.73±0.21, 6.00±0.00, 5.70±0.00 respectively. During the storage periods a significant decrease in PH was observed. It might be due to the storage temperature, method of packaging i.e., Modified Atmosphere Packaging (MOP) and Vacuum packing (VP), amount of acid content, and amount of CO_2 present in fruits and vegetables. Abdul-Raouf et.al., (1993)conducted study on PH of salad vegetables, the results shows that the PH was found to be decreased in minimally processed vegetables packed under MOP(3%-O_2,97%-N_2)and stored under temperature of 5^{o}c,12^{o}c, and21^{0}c[17]. Garcia Gimeno& Zurera-Cosano (1997) studied shelf life of ready to eat vegetable salads. Results

of the study showed that in a mixed vegetable salad, PH decrease from 7.0to4.0 after 9days of storage at 15^0c, this reduction could be related to the higher concentration of CO_2 found at this temperature.

Minimally processed fruits and vegetables	PH			F-value	Sig
	Mean ±SD				
	0 day	3rd day	5th day		
Pine apple	3.48±0.03	3.20±0.00	3.00±0.00	637	0.000*
Cabbage	6.73±0.21	6.00±0.00	5.70±0.00	58.692	0.000*

Table No: 3 PH of minimally processed pine apple and cabbage during various storage periods.

The data from table no.4, mean values for acidy of minimally processed pine apple and cabbage at0, 3^{rd}, 5^{th} days were 0.03±0.01, 0.10±0.00, 0.8±0.00 respectively and 1.10±0.01, 1.02±0.01, and 0.99±0.01 for minimally processed cabbage. The results showed that a specific decrease in acidity on storage periods. Carlin et.al.,(1990) carried out a study on effect of controlled atmosphere on microbial spoilage, electrolyte leakage and sugar content on fresh, ready to use grated carrots. The results showed that the malic acid was decreased in grated carrots packed under MOP(10%-O_2,40%-CO_2) for 10 days at 10^0c [18].

Minimally processed fruits and vegetables	Acidy			F-value	Sig
	Mean ±SD				
	0 day	3rd day	5th day		
Pine apple	0.13±0.01	0.10±0.00	0.08±0.00	196	0.000*
Cabbage	1.10±0.01	1.02±0.01	0.99±0.01	145.5	0.000*

Table No: 4 Acidity of minimally processed pine apple and cabbage during various storage periods

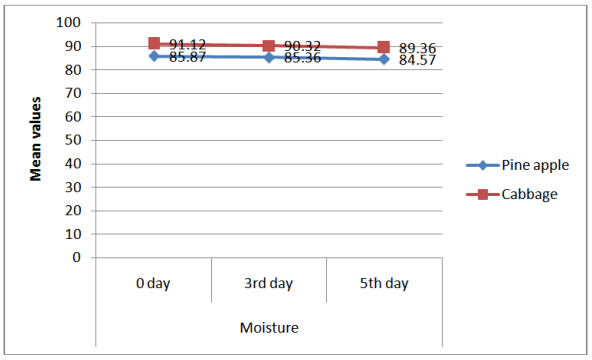

Figure No: 1 Moisture content of minimally processed fruits and vegetables during various storage periods

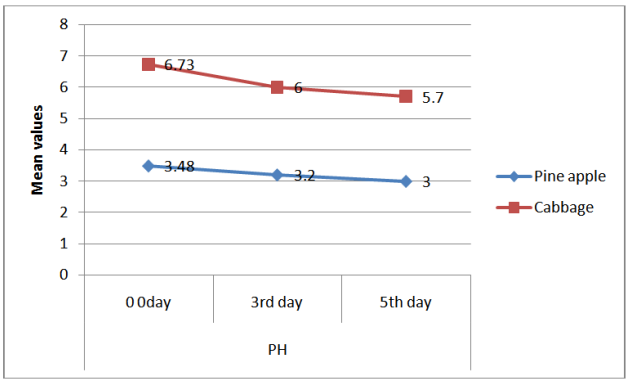

Figure No: 3 PH of minimally processed Fruits and vegetables during various storage periods

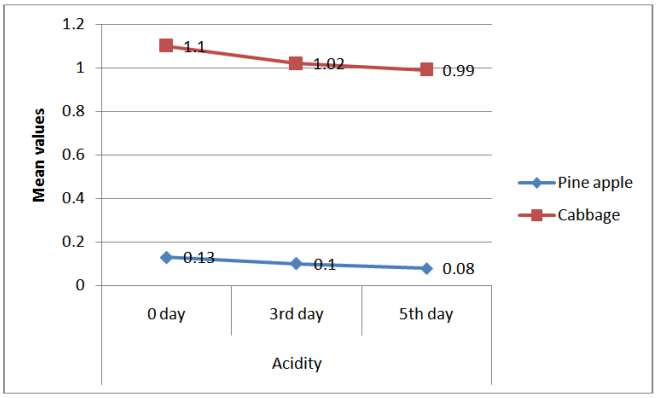

Figure No: 2 Acidity of minimally processed Fruits and vegetables during various storage periods

Data regarding Total Plate Count(TPC) in the table no:5 shows the mean values of minimally processed pine apple at 0, 3rd, 5th days were 5626.67±88.08, 200090.00±52.92, 5883333.33±104083.30 respectively and 3153.67±288.96, 198666.67±1154.70, 5300000±264575.13 for cabbage. A significant increase in TPC was observed during storage. The reasons for increase in TPC was might be due to inadequate hygiene of processors and operators, higher susceptibility towards microbial spoilage, increased respiration rate and ethylene production, tissue damages during unit operations, coarse and abrasion peeling increase the microbial content over that of hand peeling[19]. Silva et.al. (2010) carried out a study on "microbial quality of minimally processed pine apple grown under good agricultural systems". Results of the study indicate that TPC of pine apple was low when it is processed under GAS, but when the processing was not carried under GAS, there was a significant increase in microbial load [20]. Dr. Sehgal (2002) carried out a study on microbiological aspect of fresh cut fruits and vegetables showed that cabbage sample collected from different locations and when analysed for TPC showed that contamination was high in main general market and least in retail outlets. This result indicates the role of environmental hygiene and the affect of minimal processing on fruits and vegetables [21].

Minimally processed fruits and vegetables	**Total plate count(TPC) Mean ±SD**			**F-value**	**Sig**
	0 day	3rd day	5th day		
Pine apple	5626.67±88.08	200090.00±52.92	5883333.33±104083.30	9260	0.000*
Cabbage	3153.67±288.96	198666.67±1154.70	5300000±264575.13	1160.77	0.000*

Table No : 5 Total plate count (Total viable cell count/gm) of minimally processed fruits and vegetable

NOTE:
P value<0.05 significant at 5% level
*Significant at 5% level

The data from the table no.6, Yeast and Moulds (cfu/g) count of minimally processed pine apple and cabbage during different storage periods that is 0, 3rd, 5th days were 786.67±5.77, 8433.33±57.54, 84000.00±1000.00, and 700±0.00, 198666.67±1154.70, 57000.00±1000.00 for cabbage. A significant increase in Yeast and moulds count was observed on storage periods. The reasons for increase might be due to in adequate employee hygiene, higher susceptibility towards microbial invasion, poor unit operations, contamination during pre and post harvest activities, contamination from potential contamination sources like soil, faces, irrigation, and insects are the main cause for the potential increase in yeast and moulds [22].

Anjezaeoku.et.al. carried out studies on microbial examination of frozen fruits and vegetables. Results showed that products are safe when processed in hygiene conditions and stored under refrigerated conditions [23].

Minimally processed fruits and vegetables	**Yeast &Moulds(Y&M) Mean ±SD**			**F-value**	**Sig**
	0 day	3rd day	5th day		
Pine apple	786.67±5.77	8433.33±57.54	84000.00±1000.00	18976	0.000*
Cabbage	700±0.00	7525.00±114.56	57000.00±1000.00	8386	0.000*

Table No: 6 Yeast &Moulds (cfu/gm) of minimally processed fruits and vegetable

NOTE:
P value<0.05 significant at 5% level
*Significant at 5% level

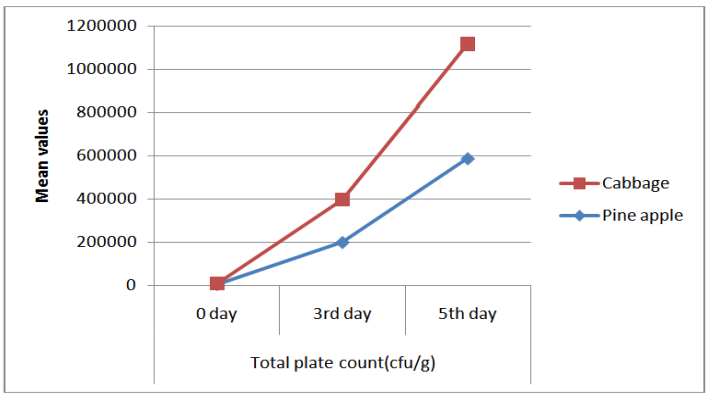

Figure No: 4 TPC (Viable cells/gm) of minimally processed fruits and vegetable

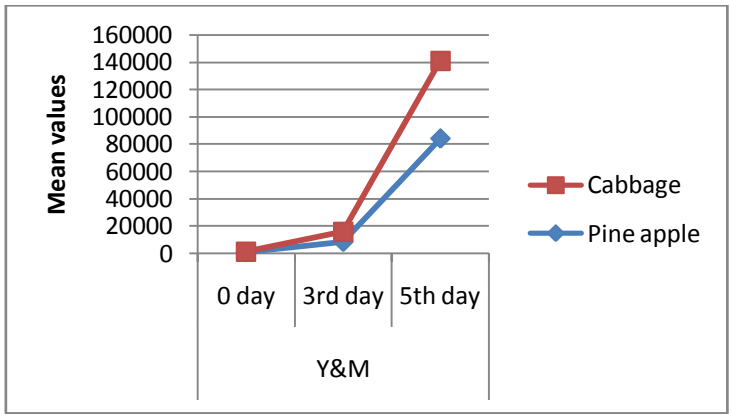

Figure No: 5 yeast &Moulds of minimally processed fruits and vegetable

IV. Conclusion

Today's society characterized by an increasing health consciousness and growing interest in the role of food for maintaining, improving human well-being and consumer health, in addition to the nutritional and sensory properties, foods are currently recognized as active and protective agents against body metabolic mall functions and body regulatory dysfunctions. The international fresh-cut produce Association (IFPA) defines fresh-Cut products as fruits or vegetables that have been trimmed, peeled, and cut into 100% usable product that is bagged or pre-packaged to offer consumers high nutrition, convenience and flavour while still maintaining its freshness. Minimally processing gives additional value to fresh-cut fruits and vegetables in terms of convenience and time savings, although several handlers are encountered problems due to the difficulty in preserving their freshness and quality during prolonged storage periods and they are also facing several risks regarding microbial and physicochemical deterioration of minimally processed fruits and vegetables. The results obtained have indicated that the microbiological and physicochemical quality of fresh-cut fruits and vegetables i.e., pine apple and cabbage sold in chittore district was poor .Hence to ensure the safety of these products in the future, it is critical that food safety control measures are effectively implemented.

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