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# Effect of different preservatives on storage ability of minimally processed cauliflower under ambient condition

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**Abstract**
The present study entitled "Effect of Different Preservatives on Storage Ability of Minimally Processed Cauliflower under Ambient Condition" was conducted in the Laboratory of Vegetable Science of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the year 2022-23. A research study was conducted, to evaluate the chemical properties at different preservative i.e., 0%, 5% & 10% brine concentration & KMS (0.2%) & Citric Acid (1%). For this study, *Brassica oleracea botrytis* was chopped, salted, and packed into glass jars and kept under ambient conditions for 28 days. The chemical analysis of Minimally Processed Cauliflower samples revealed an increasing trend in TSS (4.9-6.6%), pH (6.67-6.96) and decreasing trend in Titrable Acidity (0.55-0.26). At the end of the study, Minimally Processed Cauliflower having treatment combination of blanched cauliflower with 10% brine concentration & 0.2% potassium metabisulphite was preferred for up to 28 days at ambient condition.

**Keywords:** Brine concentration, physio-chemical, TSS, KMS & *Brassica oleracea* L. *botrytis*

## Introduction
Cauliflower (*Brassica oleracea* var. *botrytis*), having Chromosome No. 2n=2x=18 which belongs to the Mustard family Brassicaceae, grown for it edible masses partially developed flower structures and fleshy stalks. It is a sun-loving, cool-season crop. It is popular and widely consumed due to its unique taste, nutritional value and bioactive compounds such as glucosinolates (Anticancer compounds) and carotenoids (Avato & Argentieri, 2015) [1]. It is also a good source of different types of vitamins like B, C, E and K, dietary fibre and folic acid, omega3 fatty acids, proteins, phosphorus, potassium, iron, magnesium and manganese (Florkiewicz, Filipiak- Florkiewicz, Topolska, Cieślik, & Kostogrys, 2014) [20]. But it is highly perishable after harvest due to its high respiration rate and high-water loss nature. Fresh cut or Minimal processing of cauliflower is becoming much more common than using the intact cauliflower in food services and retail markets as a convenience product, as consumer preferences for ready-to- use or ready-to-eat vegetables are increasing (Escalona, Aguayo, & Artes, 2007) [21]. The main postharvest problems affecting shelf life of cauliflower during marketing are yellowing of the curd, floret opening, loss of hardness, the development of an undesirable odour, off-flavours and the risk of microbial development (Licciardello *et al*., 2013; Zhan, Hu, Pang, Li, & Shao, 2014) [6].
Minimal Processing is a growing trend in food processing that offers convenience, freshness, nutrition, and safety without synthetic chemicals. This trend focuses on enhancing value while minimizing product transformation. A study evaluated the physio-chemical properties of steeped cauliflower using multivariate statistical techniques, such as CRD, to preserve it using different barriers like sodium chloride, acetic acid, and potassium metabisulphite for longer preservation periods.

## Material and Methods
The present investigation is carried out in the Laboratory of Vegetable Science of Indira Gandhi Krishi Vishwavidyalaya Raipur (C.G.) during the year 2022-2023. The present study is "Effect of Different Preservatives on Storage Ability of Minimally Processed Cauliflower under Ambient Condition." A Minimally Processed Cauliflower is designed in CRD (Completely Randomized Design) with different concentration of brine & preservative having 13 treatments and 3 replications. The treatment combinations of present investigation are given below in Table 1. For this investigation freshly harvested Cauliflower
was collected from the Horticulture Nursery IGKV, Raipur (C.G.)

| | Treatments Details |
|---|---|
| $T_1$ | Blanched Cauliflower + 0% brine conc. + Potassium Metabisulphite (0.2%) |
| $T_2$ | Blanched Cauliflower + 5% brine conc. + Potassium Metabisulphite (0.2%) |
| $T_3$ | Blanched Cauliflower + 10% brine conc. + Potassium Metabisulphite (0.2%) |
| $T_4$ | Blanched Cauliflower + 0% brine conc. + Citric acid (1%) |
| $T_5$ | Blanched Cauliflower + 5% brine conc. + Citric acid (1%) |
| $T_6$ | Blanched Cauliflower + 10% brine conc. + Citric acid (1%) |
| $T_7$ | Unblanched Cauliflower + 0% brine conc. + Potassium Metabisulphite (0.2%) |
| $T_8$ | Unblanched Cauliflower + 5% brine conc. + Potassium Metabisulphite (0.2%) |
| $T_9$ | Unblanched Cauliflower + 10% brine conc. + Potassium Metabisulphite (0.2%) |
| $T_{10}$ | Unblanched Cauliflower + 0% brine conc. + Citric acid (1%) |
| $T_{11}$ | Unblanched Cauliflower + 5% brine conc. + Citric acid (1%) |
| $T_{12}$ | Unblanched Cauliflower + 10% brine conc. + Citric acid (1%) |
| $T_{13}$ | Unblanched Cauliflower (Control) |

**Procurement of raw materials**

A 50 kg cauliflower was collected from IGKV, Raipur, and washed and cut into 3-4 cm pieces. The cauliflower was divided into lots, sub lots, and sub-sub lots for various treatments. Solutions were prepared with different concentrations of salt, KMS, and citric acid. Whole pieces were divided into two parts, and one lot was blanched in boiling water for 4 minutes, then drained and filled with steeping solutions. The second lot was washed and packed in sterilized glass jars, filled with different combinations. The jars were stored at ambient conditions and analyzed for chemical characteristics.

**Determination of pH**

pH refers to the negative logarithm of hydrogen ion concentration.

$$pH = -\log(H^+)$$

pH was determined by using digital pH meter. The samples were taken individually in a beaker and pH meter was dipped into it and the readings were noted carefully.

**Determination of Total soluble solids (TSS) %**

TSS content of a product was determined by the index of refraction. It is measured by using hand refractometer, and also referred as degrees Brix. It tests the solids concentration of a sucrose containing solution. A few drops of sample were placed on hand refractometer and total soluble solids were recorded on the scale of the instrument and it is expressed in percent (%).

**Determination of Acidity (%)**

5 ml sample was taken and dissolved in 50 ml of distilled water and from this 20 ml aliquot was taken out and titrated with 0.1 N NaOH using few drops of phenolphthalein as indicator. End point was judged by the appearance of pink colour. The acidity of the juice is expressed in terms of percent acidity. Acidity was calculated by finding out titre value with the help of following formula.

$$\text{Acidity (\%)} = \frac{\text{Titre value} \times \text{Normality} \times \text{Eq. wt. of acid} \times \text{volume made up} \times 100}{\text{Weight of sample taken} \times \text{sample taken for estimation} \times 1000}$$

**Results and Discussion**

**Total Soluble Solid**

The TSS of minimally processed cauliflower has been presented in (Table. 2) and graphically depicted in figure.1. The critical evaluation of the data showed that the effect of different treatment combinations on TSS content of minimally processed cauliflower during storage period was found significant on all days of storage. The TSS value at 0 day of storage was recorded maximum for $T_{12}$ having (4.9%). While the minimum TSS of (1%) was noted in treatment $T_1$ & T13. The TSS value at 7th day of storage was recorded maximum for $T_{12}$ having (5.6%). While the minimum TSS of (1.3%) was noted in treatment $T_1$. The TSS value at 14th day of storage was recorded maximum for $T_{12}$ having (6.3%) followed by $T_9$ having TSS (5.3%). While the minimum TSS of (1.6%) was noted in treatment $T_1$. The TSS value was recorded maximum for $T_{12}$ having TSS (6.6%). While the minimum TSS was noted on $T_1$ (2.3%) at 21 days of storage. The TSS value at 28 days of storage was recorded maximum for $T_{12}$ having (6.6%). While the minimum TSS of (2.3%) was noted in treatment $T_1$. From the above observation it was found that the TSS content of the minimally processed cauliflower increased significantly from 0 day to 28th days of storage period. The TSS content of $T_{12}$ remains maximum during all the storage days and increased from (4.9% to 6.6%) from 0 day to 28th day and minimum TSS was recorded for $T_1$ which increased from (1% to 2.3%) for 0 day to 28th day. It is vivid from the above observation that minimum changes in TSS was observed for $T_3$ which implies that it is the most stable treatment among all the other treatment having treatment combination of blanched cauliflower with 10% brine concentration & 0.2% potassium metabisulphite. While $T_9$ & $T_{13}$ shows maximum changes during storage.

The increase in TSS content during storage of minimally processed cauliflower over a period of time might be attributed to loss of moisture and breakdown of sugars and starches. Our finding for TSS is in conformity with the observation recorded by Gupta *et al.* (1992) [4]. They observed the effect of steeping preservation of red chillies immersed in solution containing different concentration of brine + KMS + acetic acid and calcium chloride for a period of 9 months and recorded an increase in TSS from 12 to 15 °Brix with advancement in storage period. Bawa and Saini (1986) [2] also reported relative increase in TSS as a result of moisture loss.

**Table 1:** Changes in TSS of Minimally Processed cauliflower during storage

| Treatments | TSS | | | | |
|---|---|---|---|---|---|
| | Storage period (in days) | | | | |
| | 0 day | 7th day | 14th day | 21st day | 28th day |
| $T_1$ | 1.0 | 1.3 | 1.6 | 2.3 | 2.3 |
| $T_2$ | 3.6 | 3.6 | 3.7 | 3.7 | 4 |
| $T_3$ | 3.6 | 3.6 | 3.6 | 3.6 | 3.8 |
| $T_4$ | 2.6 | 2.6 | 2.6 | 3.3 | 3.7 |
| $T_5$ | 3.4 | 3.6 | 3.7 | 4.3 | 4.5 |
| $T_6$ | 3.4 | 3.7 | 3.8 | 4.2 | 4.4 |
| $T_7$ | 1.3 | 2.3 | 2.7 | 3.3 | 3.2 |
| $T_8$ | 4.3 | 4.3 | 4.6 | 4.7 | 4.8 |
| $T_9$ | 4.4 | 4.5 | 5.3 | 5.5 | 6.4 |
| $T_{10}$ | 2.3 | 2.3 | 2.6 | 2.9 | 3.3 |
| $T_{11}$ | 4 | 4.5 | 4.5 | 4.6 | 5.3 |
| $T_{12}$ | 4.9 | 5.6 | 6.3 | 6.6 | 6.6 |
| $T_{13}$ | 1.0 | 2.1 | 2.3 | 2.6 | 3 |
| Mean | 3.0 | 3.4 | 3.6 | 4.0 | 4.2 |
| SE (m)± | 0.095 | 0.099 | 0.145 | 0.183 | 0.132 |
| CV (%) | 5.331 | 5.072 | 6.878 | 7.941 | 5.370 |
| CD at 5% | 0.276 | 0.289 | 0.421 | 0.533 | 0.385 |

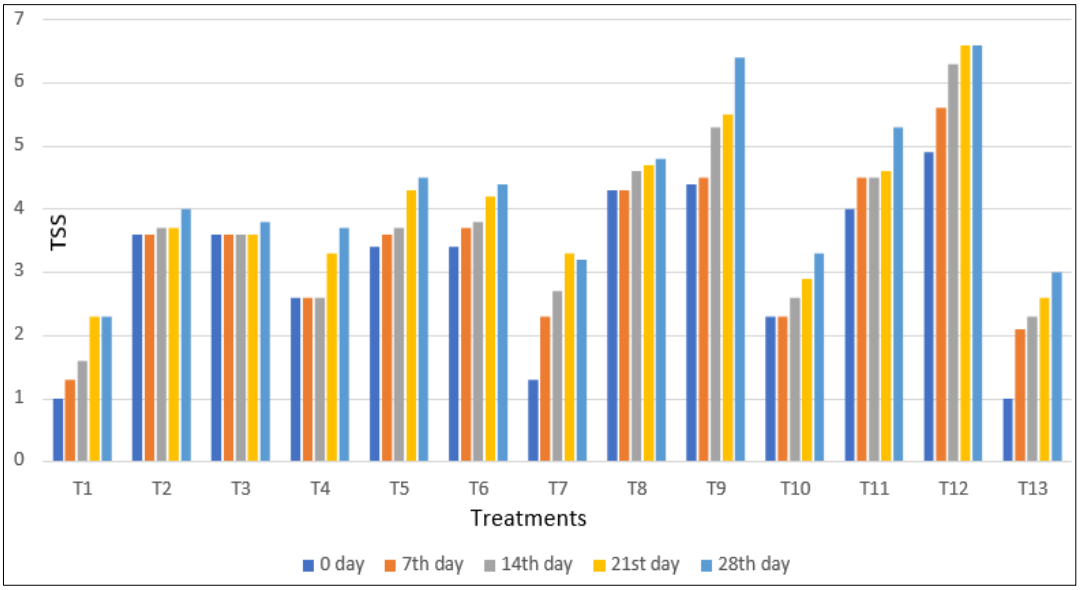


**Fig 1:** Changes in TSS of Minimally Processed cauliflower during storage

**pH**

The pH of minimally processed cauliflower has been presented in (Table.3) and graphically depicted in (Figure.2). The findings (Table 4.7 and Fig 4.3) of the data showed that the effect of different treatment combinations on pH content of minimally processed cauliflower during storage period was found significant on all day of storage period. The pH value at 0 day of storage was recorded maximum for $T_8$ having (6.67) followed by $T_9$ having pH (6.53). While the minimum pH of (4.15) was noted in treatment $T_{12}$.The pH value at 7$^{th}$ day of storage was recorded maximum for $T_8$ having (6.71) followed by $T_9$ having pH (6.5). While the minimum pH of (4.2) was noted in treatment $T_{12}$. The pH value at 14$^{th}$ day of storage was recorded maximum for $T_8$ having (6.77) followed by $T_9$ having pH (6.66). While the minimum pH of (4.23) was noted in treatment $T_{12}$ followed by $T_{11}$ (4.45). The pH value at 21st day of storage was recorded maximum for T8 having (6.85) followed by $T_9$ having pH (6.75) respectively. While the minimum pH of (4.33) was noted in treatment $T_{12}$ followed by $T_{11}$ (4.55). The pH value at 28th day of storage was recorded maximum for $T_8$ having (6.96) followed by $T_2$ having pH (6.80). While the minimum pH of (4.45) was noted in treatment $T_{12}$. From the above observation it was found that the pH content of the minimally processed cauliflower increases significantly from 0 day to 28th days of storage period. The pH content of T8 remains maximum during all the storage days and increased from (6.67 to 6.96) from 0 day to 28$^{th}$ day and minimum pH was recorded for $T_{12}$ which increased from (4.15 to 4.45) for 0 day to 28th day. It is vivid from the above observation that minimum changes in pH was observed for $T_3$ which implies that it is the most stable treatment among all the other treatment having treatment combination of unblanched cauliflower with 10% brine concentration & 0.2% KMS. While $T_{13}$ shows maximum changes during storage.

The slightly increase in pH content during storage of minimally processed cauliflower over a period of time might be due to the decreased acidity during storage. Similar results were observed by Chitarra and Chitarra (2005) [3] the titratable acidity in fruits and vegetables might be due to organic acids

which are dissolved in the vacuoles of the cells either free from, as combined with salts, esters, glycosides. Reduction in titratable acid content was also reported by Muzzaffar *et al.* (2016) [10] and Santos *et al.*, (2016) [14] in minimally processed pumpkins. The slight increase in pH value might be due to the decreased acidity during storage (Mehta and Bajaj, 1983). Similar results were also observed by Sadhu *et al.* (1985) [13] and Thakur and Barwal (1998) [19].

**Table 2:** Changes in pH of Minimally Processed cauliflower during storage

| Treatments | PH | | | | |
|---|---|---|---|---|---|
| | Storage period (in days) | | | | |
| | 0 day | 7th day | 14th day | 21st day | 28th day |
| $T_1$ | 5.66 | 5.70 | 5.78 | 5.80 | 5.85 |
| $T_2$ | 5.57 | 5.71 | 5.76 | 5.78 | 5.86 |
| $T_3$ | 5.65 | 5.70 | 5.78 | 5.80 | 5.82 |
| $T_4$ | 4.56 | 4.60 | 4.63 | 4.68 | 4.76 |
| $T_5$ | 4.37 | 4.48 | 4.53 | 4.63 | 4.70 |
| $T_6$ | 4.3 | 4.41 | 4.50 | 4.60 | 4.65 |
| $T_7$ | 6.27 | 6.37 | 6.47 | 6.57 | 6.60 |
| $T_8$ | 6.67 | 6.70 | 6.77 | 6.85 | 6.96 |
| $T_9$ | 6.53 | 6.58 | 6.65 | 6.75 | 6.80 |
| $T_{10}$ | 4.61 | 4.72 | 4.83 | 4.95 | 5.05 |
| $T_{11}$ | 4.38 | 4.40 | 4.49 | 4.55 | 4.61 |
| $T_{12}$ | 4.15 | 4.2 | 4.25 | 4.33 | 4.45 |
| $T_{13}$ | 5.09 | 5.08 | 5.2 | 5.8 | 6.06 |
| Mean | 5.20 | 5.27 | 5.35 | 5.46 | 5.54 |
| SE (m)± | 0.076 | 0.068 | 0.060 | 0.101 | 0.108 |
| CV (%) | 2.537 | 2.257 | 1.996 | 3.326 | 3.489 |
| CD at 5% | 0.223 | 0.198 | 0.177 | 0.295 | 0.314 |

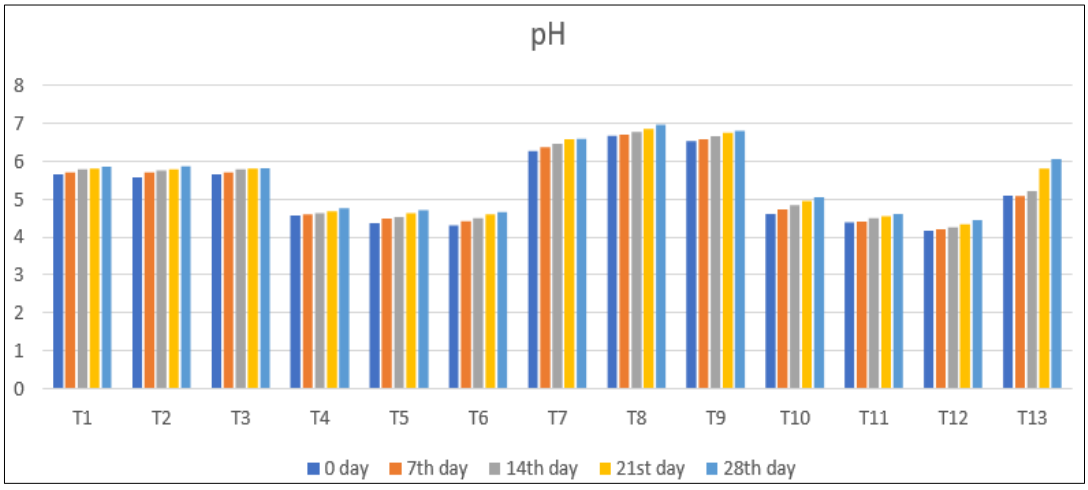


**Fig 2:** Changes in pH of Minimally Processed cauliflower during storage

**Acidity**

The Acidity of minimally processed cauliflower has been presented in (Table. 4) and graphically depicted in (Figure. 3).The critical evaluation of the data showed that the effect of different treatment combinations on Acidity content of minimally processed cauliflower during storage period was found significant on all day of storage period. The Acidity value at 0 day of storage was recorded maximum for $T_{12}$ having (0.55%). While the minimum Acidity of (0.3%) was noted in treatment $T_3$. The Acidity value at 7th day of storage was recorded maximum for $T_{12}$ having (0.5%). While the minimum Acidity of (0.29%) was noted in treatment $T_3$. The Acidity value at 14th day of storage was recorded maximum for $T_{12}$ having (0.45%). While the minimum Acidity of (0.25%) was noted in treatment $T_2$. The Acidity value at 21st day of storage was recorded maximum for $T_6$ & $T_{12}$ having (0.35%). While the minimum Acidity of (0.2%) was noted in treatment $T_1$, $T_2$, $T_8$. The Acidity value at 28th day of storage was recorded maximum for $T_{12}$ having (0.3%). While the minimum Acidity of (0.14%) was noted in treatment T8. From the above observation it was found that the Acidity content of the minimally processed cauliflower decreased significantly from 0 day to 28th days of storage period. The Acidity content of $T_{12}$ remains maximum during all the storage days and decreased from (0.55% to 0.3%) from 0 day to 28$^{th}$ day and minimum Acidity was recorded for $T_3$ which decreased from (0.3% to 0.26%) from change 0 day to 28th day. It is vivid from the above observation that minimum change in Acidity was observed for $T_3$ which implies that it is the most stable treatment among all the other treatment having treatment combination of blanched cauliflower with 10% brine concentration & 0.2% potassium metabisulphite While $T_{11}$ shows maximum change during storage.

The slightly decrease in acidity content during storage of minimally processed cauliflower over a period of time might be due to the loss of volatile acids & increase in pH. Similar

results were observed by Lima *et al*. (2019) [7] the shelf life and quality of minimally processed pumpkin and reported that during storage there was a significant increase in weight loss and reduction in firmness index, color, soluble solids and titratable acidity. So that 'Regional' pumpkins were more resistant to the preservation of these characteristics over 12 days compared to Cobatia. Gupta *et al*., (1992) [4] also recorded decrease in acid contents with the advancement of storage period in steeping preservation of red chillies. The reduction in acidity of steeped vegetables during storage has been observed by Pruthi *et al*. (1980) [11] while working with the determination of optimum condition of preservation of fresh vegetables in acidified brine. The decrease in titratable acidity might be due to loss of volatile acids during storage (Sadhu *et al*., 1985 and Reynolds, 1965) [13, 12]. Our results are in conformity with the finding of earlier workers.

**Table 3:** Changes in Acidity of Minimally Processed cauliflower during storage

| Treatments | Acidity | | | | |
|---|---|---|---|---|---|
| | Storage period (in days) | | | | |
| | 0 day | 7th day | 14th day | 21st day | 28th day |
| $T_1$ | 0.34 | 0.33 | 0.28 | 0.2 | 0.19 |
| $T_2$ | 0.35 | 0.3 | 0.25 | 0.2 | 0.18 |
| $T_3$ | 0.3 | 0.29 | 0.28 | 0.28 | 0.26 |
| $T_4$ | 0.45 | 0.43 | 0.33 | 0.30 | 0.25 |
| $T_5$ | 0.44 | 0.4 | 0.35 | 0.30 | 0.24 |
| $T_6$ | 0.5 | 0.45 | 0.4 | 0.35 | 0.25 |
| $T_7$ | 0.37 | 0.30 | 0.30 | 0.25 | 0.15 |
| $T_8$ | 0.39 | 0.32 | 0.25 | 0.2 | 0.14 |
| $T_9$ | 0.4 | 0.35 | 0.3 | 0.25 | 0.25 |
| $T_{10}$ | 0.48 | 0.4 | 0.35 | 0.3 | 0.25 |
| $T_{11}$ | 0.49 | 0.45 | 0.35 | 0.25 | 0.19 |
| $T_{12}$ | 0.55 | 0.5 | 0.45 | 0.35 | 0.3 |
| $T_{13}$ | 0.46 | 0.4 | 0.35 | 0.30 | 0.25 |
| Mean | 0.42 | 0.37 | 0.32 | 0.27 | 0.22 |
| SE (m)± | 0.011 | 0.010 | 0.009 | 0.007 | 0.006 |
| CV (%) | 4.664 | 4.984 | 5.279 | 4.884 | 5.419 |
| CD at 5% | 0.044 | 0.031 | 0.028 | 0.022 | 0.020 |

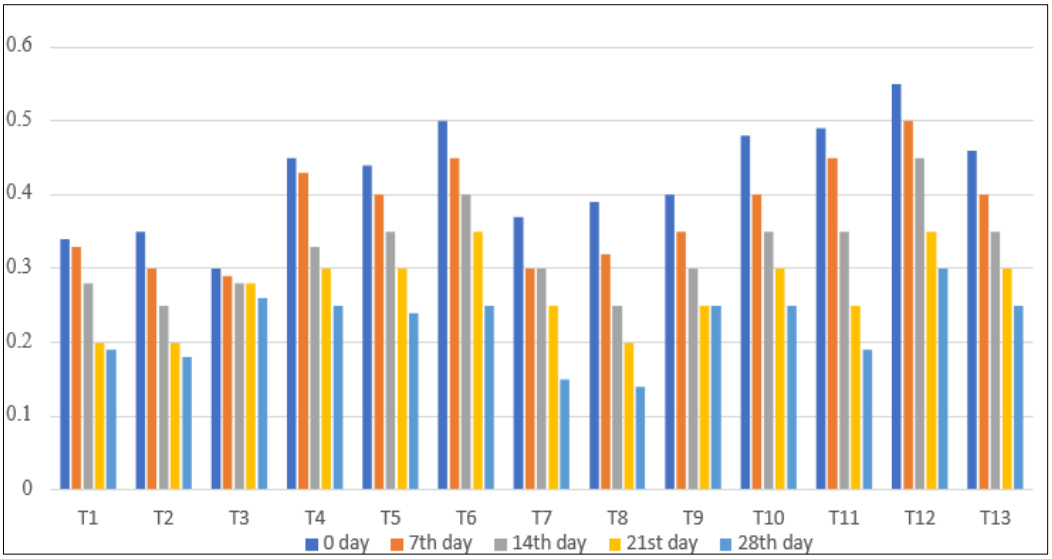


**Fig 3:** Changes in Acidity of Minimally Processed cauliflower during storage

## Conclusion

This research emphasizes the development of Minimally Processed Cauliflower at different preservatives. This study of chemical analyses indicates that a safe and high-quality Minimally Processed Cauliflower can be prepared at high salt concentrations & preservatives. When produced under good manufacturing and sanitation practices, blanched cauliflower with 10% brine concentration & 0.2% potassium metabisulphite was preferred for up to 28 days at ambient condition. While throughout the storage period it was observed that TSS of $T_1$ having maximum TSS content increased from (4.9% to 6.6%) and $T_1$ having minimum content increased from (1% to 2.3%), pH for T8 maximum pH content which increased from (6.67 to 6.96) and $T_1$ having minimum pH increased from (4.15 to 4.45), acidity for $T_{12}$ was noted highest which decreased from (0.55% to 0.3%) and minimum was observed in $T_3$ which decrease from (0.3% to 0.26%).

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