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Evaluation of Produced Pickles Quality from Caper Fruits and Buds

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ABSTRACT

The aim of the present study was to assess the buds and fruits of caper which were pickled in brines (5 %, 8 % and 10 %) and dry salt for 3 months. The chemical properties and Sensory evaluation of pickled caper buds and fruits were determined and their brines were analyzed for chemical and total count bacteria during storage at room temperature for 3 months. The obtained results showed that treatment of 5% (T1) recorded the highest moisture content while, dry salt treatment (T4) possessed lowest moisture content comparing to the other treatments either for buds or fruits. The highest T.S.S was found in caper buds for T4 about (24.8, 27.6 and 27.3% for 1, 2 and 3 months respectively). The acidity percentage of pickled caper buds and fruits was ranged between 0.077 % and 0.274% during storage period. Treatment of 8% salt solution (T2) for pickled caper buds and fruits had the highest total phenolic contents (76 and78 mg Gallic acid equivalents /g), respectively) while, T4 for pickled caper buds had the lowest value which recoded (30 mg Gallic acid /g) after one month and there was a gradually significant ($P<0.05$) decrease in TPC of all treatments at 2nd and 3rd months. T.S.S of brines was increased with the increase of salt concentration in fresh solutions and pickled caper buds and fruits. While acidity of freshly solutions was significantly ($P<0.05$) decreased by increasing the concentration of the salt. On the other hand, a significant ($P<0.05$) difference was observed in pH among all freshly solutions and pickled caper buds and fruits brines during storage at room temperature for 3 months. Caper buds brine for T2 had a higher content of flavonoids (1.92 mg quercetin equivalents /g) after 1st month. According to the results of total bacterial count, increasing the concentration of the salt solutions led to decrease the total bacterial count for buds brines and T4 was the lowest values after1st month of pickling for buds comparing with the other treatments. Pickled caper fruits had the highest scores for all sensory properties while the least preferred were obtained for all treatments of pickled caper buds especially T4 within 1st, 2nd and 3rd months.

Keywords: Caper, buds, fruits, pickles, brines, chemical properties, Sensory evaluation.

1. Introduction

Pickles are good appetizers, consumed by all age of people and contain large amounts of lactobacilli bacteria which are important for the digestion of grains and vegetables and have usual beneficial probiotic properties for the body (Girdhari *et al.,* 2010; Panda *et al.,* 2007).

Fermentation is one of the oldest methods of food preservation and has many benefits as it works to give taste, smell, color and textures to fermented food make the food is different from the raw material made from them (Choi *et al.,* 2013).

Fermented vegetables are good sources of natural antioxidants such as vitamins, carotenoids, flavonoids and other phenolic compounds (Takebayashi *et al.,* 2013; Isa-belle *et al.,* 2010).

The consumption of lactic acid bacteria fermented vegetables helps to enhance human nutrition with the attainment of balanced nutrition, providing vitamins, minerals, and carbohydrates besides; they contain pigments such as flavonoids, lycopene, anthocyanin, β-carotene, and glucosinolates (Yamano *et al.,* 2006).

These phytochemicals act as antioxidants in the body by scavenging harmful free radicals implicated in degenerative diseases like cancer, arthritis, and ageing (Kaur and Kapoor, 2001).

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Capers are appreciated for their pungent and bitter flavor and are used as an appetizer with olives, cheese, and nuts or as a complement to meat, salads, pasta, and other foods. The aromatic floral buds are gathered just before blooming and stabilized either in brine or in salt. During this processing the plant glucosinolates are converted to their cognate isothiocyanates, responsible for the characteristic flavor of the caper, in a concomitant fermentation process (Brevard *et al.,* 1992; Fahey *et al.,* 2001).

The fresh aerial parts of caper, including the fruit and the flower buds, are usually stored in salt and vinegar, or brined and used as an appetizer with olives, cheese and nuts or as a complement to meat, salads or pasta. Additionally, fruits with small, soft seeds are preferred for the production pickles (Trombetta *et al.,* 2005; Tlili *et al.,* 2009). Capers have important roles in the food industry. The fruits are stored in brine and have become a costly product during recent years.

In Egyptian deserts, *Capparis spinosa* var. Egyptian (Lam.) is a perennial plant growing wildly. Caper fruit and bud are the common parts for edible uses (Saad and Said, 2011). For many years, *Capparis Sinaica veill* has been used in the Egyptian folk medicine for many different uses. The presence of bioactive components such as flavonoids, glycosides, sterols, tannins, alkaloids, saponins, resins and carbohydrates has been revealed using Phytochemical screening of the caper (Ghazal El-Saied *et al.,* 2015).

Therefore, this investigation intended to produce pickles from caper buds and fruits by using pickling brines (5 %, 8 % and 10 %) and dry salt at room temperature for 3 months. The chemical and Sensory properties were evaluated to determine the acceptability of these pickled products in our country.

2. Materials and Methods

2.1. Materials

- Buds, and fruits of caper (*Capparis spinosa* L.) were collected in August 2018, from Nuweiba, South Sinai, Egypt.
- Salt (sodium chloride) were obtained from a local market (Cairo, Egypt).
- Solvents and all chemicals: were obtained from El-Gomhoria Co. Cairo, Egypt.

2.2. Methods

Buds and fruits of caper were preserved in cooled conditions until used and salt were used for preparing the brines.

Treatment Solutions

-Wet salting

Preparation of pickling brines solutions as follows:

Treatment 1: 5% Sodium chloride + 0.5% Citric acid (T1)
Treatment 2: 8% Sodium chloride + 0.5% Citric acid (T2)
Treatment 3:10% Sodium chloride + 0.5 Citric acid (T3)

Caper buds and fruits were cleaned and placed in jars then, add the pickling solutions separately, and the jars were closed tightly and left for 90 days (Özcan and Akgül, 1999; Douieb *et al.,* 2010).

Dry salting

Treatment 4: The buds and fruits were mixed with 40% dry salt as according (Tesoriere *et al.,* 2007) and have been put or were laid in alternate layers, in glass jars for 3 months.

Pickled samples were left in their own brines at room temperature for 3months and were evaluated once every one month.

Analytical methods

All studied of pickled caper (buds and fruits) and brines as affected by using different concentration of salt from the previous treatments were evaluated in relation to:

- The moisture content in a vacuum oven according to AOAC, (2000).
- The total soluble solids (TSS) as the Brix value was read using a digital refractometer (DR 6000, A. Kruss Optronic GmbH, Hamburg, Germany).

- The titratable acidity (expressed as citric acid %) was determined as follows: 10gm of sample was taken in a 250 ml beaker and 50 ml of distilled water was added. The content was titrated with 0.1 N sodium hydroxide, using phenolphthalein as an indicator to an, end-point and the data was reported as the percentage of citric acid content (AOAC, 2000).
-The pH value was measured by using a Systronic324- combination glass electrode pH meter at 25°C.
- Polyphenols content was determined as total polyphenols according to Swain and Hillis, (1959) and all values were expressed as mg of Gallic acid equivalents/g (mg GAE/g).
- The total flavonoid contents were measured spectrophotometrically (Yoo *et al.,* 2008). Absorbance at 510 nm. was read, and flavonoid content in triplicate was measured and expressed as mg Quercetin equivalents/g (mg QE/g).

Determination of total bacterial count (TBC)

Total bacterial count was carried out using the method by Frazier (1976), 1 g of representative sample was minced and weighed into a sterile test tube containing 9 ml of ringer's solution, the sample was mixed thoroughly by shaking to 10 serial dilutions. Each dilution was aseptically transferred into triplicate sets of disposable sterile petri-dishes which contain nutrient agar. The petri-dishes were mixed and gentle shaken and allowed to form solid. These were incubated at 37 °C for 24 h after which the colonies were counted. Results were expressed as cfu/gm sample.

Sensory evaluation

Sensory characteristics evaluation of the pickled caper buds and fruits as affected by addition different concentration of salt liquids during storage at room temperature for 3months. The pickled caper buds and fruits were evaluated by 15 panelists from the staff of the Agriculture Industrialization Unit, Desert Research Center. Panelists were asked to evaluate pickled caper for taste, odor, texture, color, appearance and overall acceptability, using the 9-point rating hedonic scale (1 – Dislike Extremely; 2 – Dislike Very Much; 3 – Dislike Moderately; 4 – Dislike Slightly; 5 - Neither Like nor Dislike; 6 - Like Slightly;7 - Like Moderately; 8 - Like Very Much; 9 – Like Extremely).

Statistical analysis

All determinations were carried out in triplicate and data is reported as mean. Significant differences ($p<0.05$) were calculated using Duncan's multiple range test, followed the method reported by Steel and Torrie, (1980).

3. Results and Discussion

3.1. Moisture content

Moisture content of pickled caper buds and fruits as affected by salt concentration during storage at room temperature for3 months was determined and the obtained results are shown in Table (1).

Table 1: Moisture content of pickled caper buds and fruits during storage at room temperature for 3 months.

Treatments	Moisture %					
	One month		Two months		Three months	
	Buds	Fruits	Buds	Fruits	Buds	Fruits
T1	83.44^{cA}	84.94^{aA}	81.42^{dA}	83.86^{bcA}	83.09^{cA}	84.62^{abA}
T2	81.000^{cB}	81.42^{bcB}	80.64^{cB}	80.56^{cB}	82.11^{abB}	82.54^{aB}
T3	79.69^{cC}	78.62^{dC}	79.94^{cC}	80.67^{bB}	81.25^{aC}	78.18^{dC}
T4	61.40^{fD}	65.50^{eD}	75.19^{bD}	80.09^{aB}	69.54^{dD}	72.68^{cD}

Values bearing the same small letter within the same row are not significantly different (P > 0.05).
Values bearing the same capital letter within the same column are not significantly different (P >0.05).

Data in Table (1), showed that the moisture content of pickled caper buds and fruits were ranged between 61.40 and 84.94% after one month of pickling. Whereas, the sample of T1 recorded the highest moisture content comparing with the other studied treatments either for buds or fruits all over the storage period. On the hand, T4 possessed lowest moisture content during the months of storage comparing to

the other treatments either for buds or fruits, this may be due to the higher salt concentration. The presented results indicated that increasing the salt concentration resulted in decrease the moisture content either for buds or fruits.

3.2. Total soluble solids (T.S.S) and acidity of pickled caper

Total soluble solids (T.S.S) and acidity of pickled caper buds and fruits during three months of storage were determined and the obtained results were tabulated in Table (2).

The results in Table (2) indicated that total soluble solids (T.S.S) of T4 was higher than all other treatments for both caper buds and fruits after 1st month of the pickling. The highest total soluble solids was found in caper buds for T4 during the storage period about (24.8, 27.6 and 27.3% for 1, 2 and 3 months respectively). The increase in total soluble solids is attributed to the high salt concentration.
From the same Table, it could be noticed that the acidity percentage of pickled caper buds and fruits was ranged between 0.077 % and 0.274% during storage period and there was a significant difference between all processed pickles. Whereas, the highest value was found in (T2) for pickled of caper fruits with 8% liquid solution at the end of storage period (3 months). While, the lowest value was noted for caper fruits pickled with dry salt T4 after one month of storage period. The presented data in Table (2) demonstrated also, that the storage period led to increase the acidity for all studied treatments either for buds or fruits, this may be due to the effect of Lactic acid bacteria (Millesca, 2021).

Table2: Total soluble solids (T.S.S) and acidity of pickled caper buds and fruits during storage for 3 months.

Treatments	T.S.S%					
	One month		Two months		Three months	
	Buds	Fruits	Buds	Fruits	Buds	Fruits
T1	10.7^{cD}	9.6^{dD}	15.3^{aB}	9.2^{eC}	12.5^{bC}	9.2^{eD}
T2	$12.7^{bc}C$	10.5^{dC}	14.2^{aC}	12.4^{cB}	12.8^{bC}	10.4^{dC}
T3	14.7^{dB}	11.7^{eB}	15.6^{cB}	21.8^{aA}	14.5^{dB}	21.5^{bA}
T4	24.8^{cA}	18.00^{dA}	27.6^{aA}	12.7^{eB}	27.3^{bA}	12.3^{fB}
	Acidity%					
	One month		Two months		Three months	
	Buds	Fruits	Buds	Fruits	Buds	Fruits
T1	0.199^{eA}	0.158^{fA}	0.251^{bA}	0.215^{dA}	0.265^{aA}	0.228^{cC}
T2	0.172^{cB}	0.099^{dC}	0.231^{bB}	0.169^{cB}	0.232^{bB}	0.274^{aA}
T3	0.199^{cA}	0.124^{eB}	0.217^{bC}	0.134^{dC}	0.231^{aB}	0.234^{aB}
T4	0.084^{eC}	0.077^{fD}	0.171^{bD}	0.122^{dD}	0.164^{cC}	0.179^{aD}

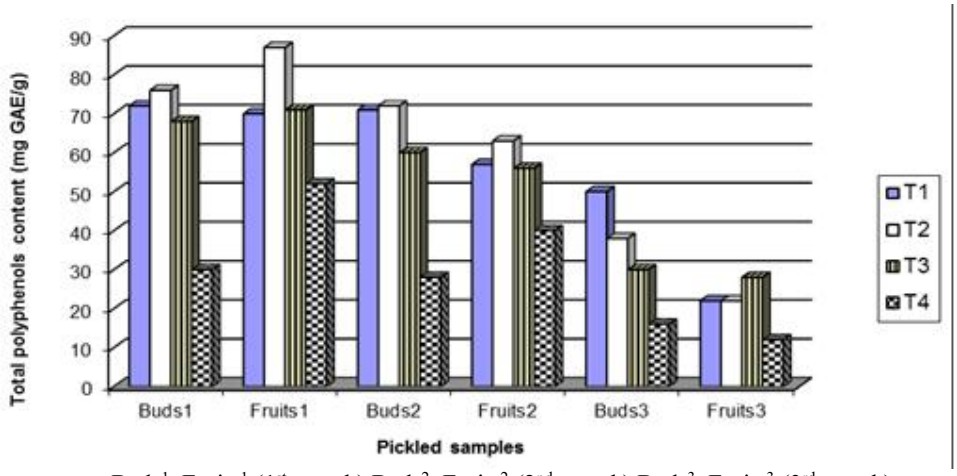
Values bearing the same small letter within the same row are not significantly different (P > 0.05) for each parameter
Values bearing the same capital letter within the same column are not significantly different (P >0.05) for each parameter.

3.3. Total polyphenol and flavonoids content of pickled caper

Total polyphenol and flavonoids content of pickled caper buds and fruits during storage at room temperature for3 months was determined and the obtained results are shown in Figures 1 and 2.

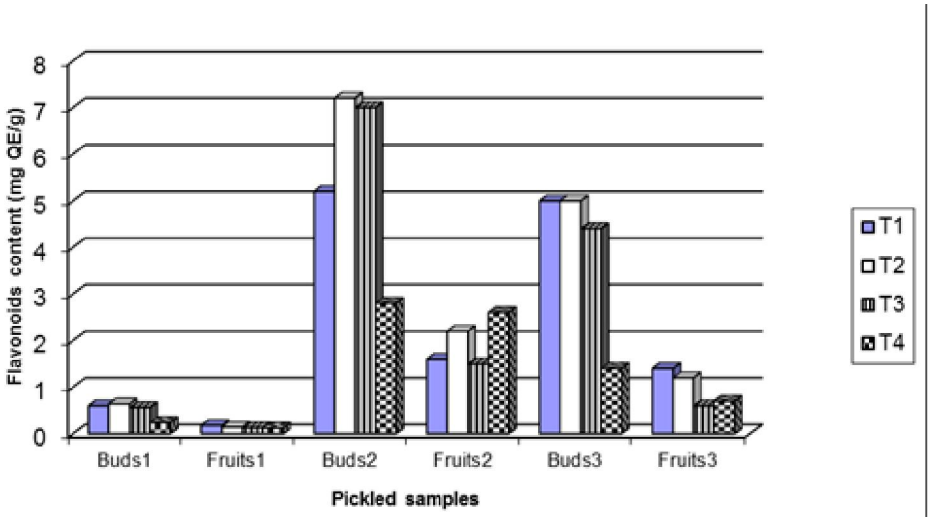
Fig. (1), shows total polyphenols content (TPC) of pickled caper buds and fruits. The TPC in the range of 12 to78 mg GAE/g sample. T2 for pickled caper buds and fruits had the highest TPC (76 and 78 mg GAE/g, respectively) while, T4 for pickled caper buds had the lowest value which recoded 30 mg GAE/g after one month. On the other hand, there was a gradually significant (P<0.05) decrease in TPC of all treatments at 2nd and 3rd months. This phenomenon could be partially attributed to the migration of the phenols into the brine and partially to the different biochemical, physiological, and structural reactions that occur during the first stage of the fermentation process. Similar results were obtained by *Jing et al., (2014)* for the fermented red radish.

Sayin and alkan (2015), reported that the pickling in 15 days there was a significant (P<0.05) decrease in TPC of all vegetables, in contrast TPC increased significantly after 30 days. At the end of 60 days TPC decreased but despite this analysis of variance revealed a significant (P<0.05) different in TPC between fresh and pickled vegetables in favor of pickled ones.



Bads[1], Fruits[1] (1st month) Bads[2], Fruits[2] (2nd month) Bads[3], Fruits[3] (3rd month)

Fig. 1: Total polyphenol content (mg gallic acid equivalent/g) of pickled caper buds and fruits during 3 months of storage



Bads[1], Fruits[1] (1st month) Bads[2], Fruits[2] (2nd month) Bads[3], Fruits[3] (3rd month)

Fig. 2: Flavonoids content (mg quercetin equvilant/g) of pickled caper buds and fruits during 3 months of storage

From Fig. (2), it could be noticed that, the highest flavonoids content was noticed for T2 of pickled caper buds (0.64 mg QE /g), and the lowest was noted for T4 of pickled caper fruits (0.12 mg QE /g) after one month of pickling. On the other hand, the flavonoids content of pickled caper buds and fruits was gradually increase in 2nd of pickling but at the end of 3rd month, the flavonoids content led to decrease for all treatments.

Different studies (Pérez-López *et al.,* 2007; Hallmann *et al.,* 2019) have addressed the divergency in the negative correlation between the TPC and TFC content. The agricultural factors remain the main variable, as well as the nitrogen content and availability, which is highly correlated with flavonoid concentration in fruits and vegetables. The fermentation conditions, such as temperature, light exposure, and type of salt, can cause variation in flavonoid concentration in green pickled tomatoes. Moreover, the structure, activity, and bioavailability of these compounds might change over-processing, as was pointed out by Rohn *et al.* (2007).

O¨zcan *et al.* (2020) demonstrated that The phenolic profile of caper buds showed variation in phenolic compounds depending on size of buds and fermentation treatment and both fresh and fermented

caper buds may be used as a possible source of natural antioxidant for various applications in food and medicine.

3.4. Total soluble solids (T.S.S) and acidity of pickled brines

Total soluble solids (T.S.S) and acidity of pickled caper buds and fruits brines during three months of storage were determined and the obtained results are shown in Table (3).

From Table (3), it could be noticed that, total soluble solids (T.S.S) percent was increased with the increase of salt concentration in fresh solutions and pickled caper buds and fruits brines .Also, total soluble solids of pickled caper buds and fruits brines was increased compering with the fresh solutions (before pickling). The highest T.S.S percentage at all storage periods was recorded forT4 either for buds or fruits compared with the other samples .The highest T.S.S recorded (23.4%) for T4 caper fruits brine which was significantly ($P<0.05$) higher as compared to other samples after 1st month .While, the lowest recorded about (8.8%) for caper fruits brine T1after 2nd month.

Data in Table (3), showed that, acidity of freshly solutions were significantly ($P<0.05$) decreased by increasing the concentration of the salt. Whereas, T1 was the highest acidity while the lowest was in T4. with regard, acidity of pickled caper buds and fruits brines was increased by the end of storage for both buds and fruits. The highest and lowest acidity values in the end of the storage were recorded forT1 and T3 pickled caper fruits brines (0.646%and0.129 %) respectively, these results agree with Belviranl *et al.,* (2016) who found that acidity of all the brines gradually decreased in 30th day, but increased in 2nd storage. the highest acidity was found in 5 % brine (about 0.70 %)at the end of the storage (3rd storage). Özcan, (1999) reported that acidity increased until 15days of fermentation and was then stable. The highest acidity (0.80%) was determined for the10% brine, C. ovata treatment after 15 days of fermentation.

Table 3: Total soluble solids and acidity of pickled caper buds and fruits brines during storage at room temperature for3 months.

Treatments	T.S.S before pickling (Fresh)	T.S.S%					
		One month		Two months		Three months	
		Brine pickled					
		Buds	Fruits	Buds	Fruits	Buds	Fruits
T1	5.8^{dC}	10.5^{bD}	10.4^{bC}	11.2^{aD}	8.8^{cC}	11.3^{aD}	9.0^{cD}
T2	8.6^{eB}	12.3^{bC}	11.6^{cB}	12.8^{aC}	10.7^{dB}	12.9^{aC}	10.5^{dC}
T3	10.2^{fA}	13.6^{cB}	11.6^{dB}	14.0^{bB}	10.6^{eB}	14.3^{aB}	11.4^{dB}
T4	-------	22.3^{cA}	23.4^{bA}	27.1^{aA}	12.1^{dA}	27.3^{aA}	12.2^{dA}
Treatments	Acidity before pickling (Fresh)	Acidity %					
		One month		Two months		Three months	
		Brine pickled					
		Buds	Fruits	Buds	Fruits	Buds	Fruits
T1	0.380^{cA}	0.144^{gA}	0.224^{fA}	0.315^{eA}	0.431^{bA}	0.358^{dA}	0.646^{aA}
T2	0.373^{aA}	0.128^{eB}	0.160^{dB}	0.302^{cB}	0.299^{cB}	0.333^{bB}	0.368^{aB}
T3	0.357^{aB}	0.112^{gC}	0.128^{fC}	0.256^{eC}	0.279^{dC}	0.304^{bC}	0.296^{cC}
T4	-----	0.096^{eD}	0.080^{fD}	0.139^{bD}	0.111^{dD}	0.167^{aD}	0.129^{cD}

Values bearing the same small letter within the same row are not significantly different ($P > 0.05$) for each parameter
Values bearing the same capital letter within the same column are not significantly different ($P >0.05$) for each parameter.

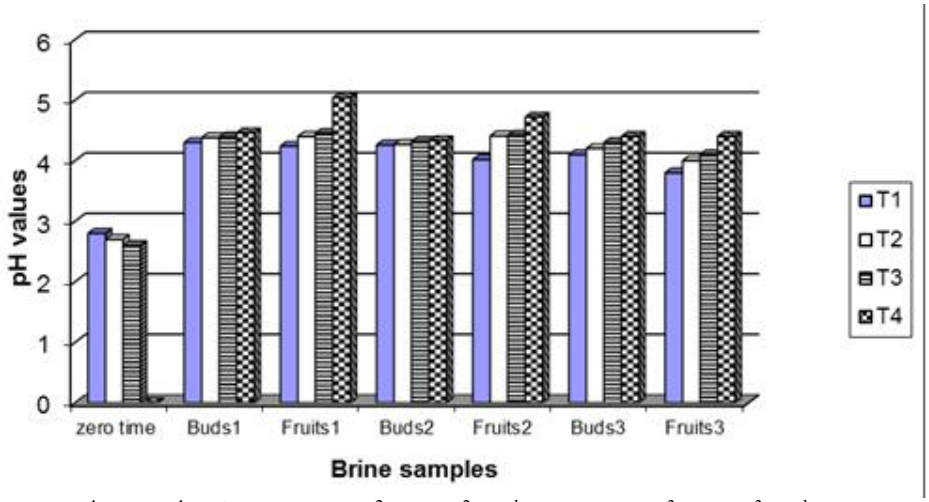
3.5. pH value of pickled brines

The pH of pickled caper buds and fruits brines during storage at room temperature for3 months was determined and the results obtained at Fig. (3).

From Fig. (3), it could be noticed that values for the pH after pickled were higher than the values of freshly solutions. After one month storage the highest pH was noticed for T4 pickled caper buds and fruits brines (4.46 and 5.04 respectively) and the lowest pH was noted for T3caper fruits brine (4.24). On the other hand, a significant ($P<0.05$) difference was observed in pH among all freshly solutions and brines pickled caper buds and fruits during storage at room temperature for3 months. There was gradually decreased for the pH values of brines pickled caper buds and fruits at all storage periods.

Ôzcan and Akgül (1999) reported that acidity values during storage were low at the samples with fresh brine of *C.ovata and C. spinosa*. pH decreased markedly in 10 % fresh brine as from initial to final

storage and acidity was higher in old brine during storage. It was reported that high salt concentrations in fermented products prevented lactic acid bacteria growth and low salt concentrations promoted the growth and provided high acid formation (Fleming, 1991). Pickles usually have pH ranged in between 4.5 to 10 in which bacteria except lactic acid bacteria are unable to survive. This make the pickle bacteria free and safe for consumption (Patel, 2019).

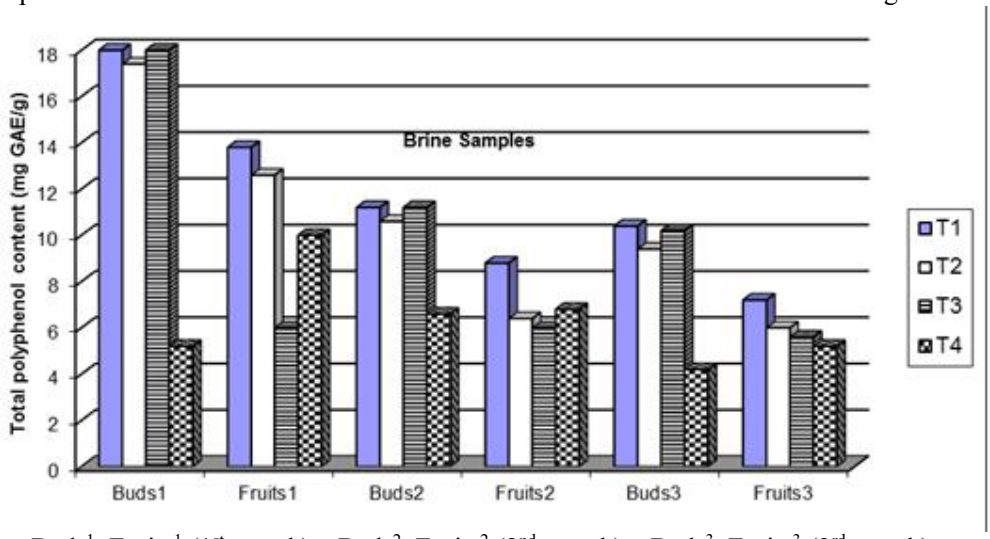


Bads[1], Fruits[1] (1st month) Bads[2], Fruits[2] (2nd month) Bads[3], Fruits[3] (3rd month)

Fig. 3: pH of pickled caper buds and fruits brines during 3 months of storage.

3.6. Total polyphenol and flavonoids content of pickled brines

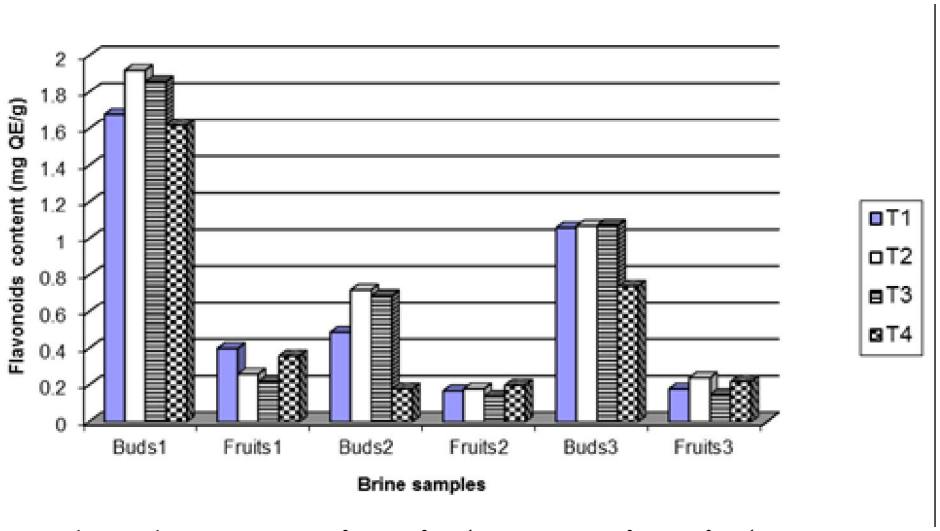
Total polyphenol and flavonoids content of pickled caper buds and fruits brines during storage at room temperature for 3 months was determined and the obtained results are shown in Figures 4 and 5.



Bads[1], Fruits[1] (1st month) Bads[2], Fruits[2] (2nd month) Bads[3], Fruits[3] (3rd month)

Fig. 4: Total polyphenol content (mg GAE/g) of pickled caper buds and fruits brines during 3 months storage**.**

From Fig. (4), it could be noticed that, Total polyphenols content (TPC) was decreased by increasing pickling period for caper buds and fruits brines. The highest TPC (18.0 mg GAE/g) was recorded for T1 caper buds brine which was significantly ($P<0.05$) higher as compared to other brine samples after 1st month while, the lowest of TPC was inT4 for the same sample at the end of pickling.



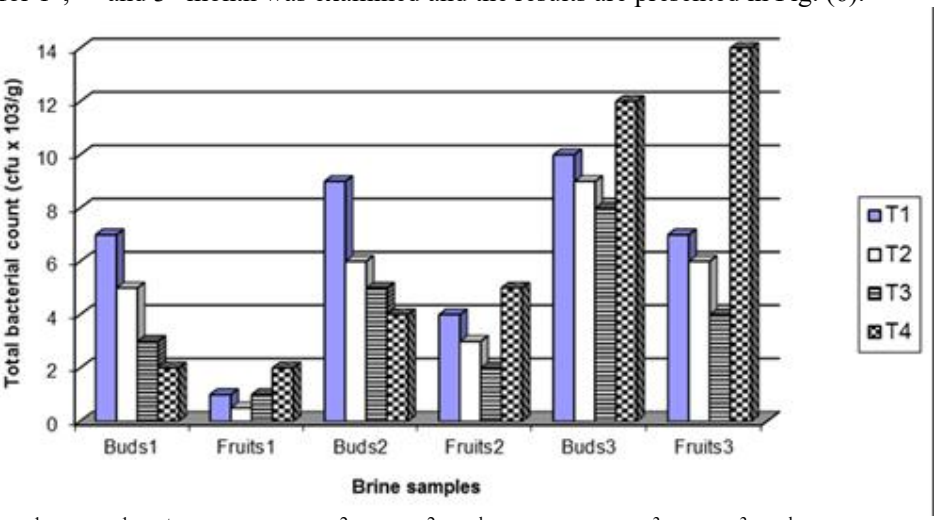
Bads[1], Fruits[1] (1st month) Bads[2], Fruits[2] (2nd month) Bads[3], Fruits[3] (3rd month)

Fig. 5: Flavonoids content (mg QE/g) of pickled caper buds and fruits brines during 3 months of storage.

Fig. (5), showed that the flavonoids content was significantly ($P<0.05$) difference by increasing the storage period whereas, caper buds brine T2 had a higher content of flavonoids (1.92 mg quercetin / g) after 1st month while the lower was in T3 (0.14mg quercetin / g) for brine pickled caper fruits. At 2nd month, there was a decline in flavonoids content of brine pickled caper for both buds and fruits. Then, it began to increase at the end of storage period, but still less than the first month. The highest flavonoids content in the end of the storage recorded for T2 and T3 brines, pickled caper buds with the same value (1.07 mg quercetin / g) while the lowest values were determined in T1 and T3 brines pickled caper fruits (0.18and0.15 mg quercetin / g) respectively.

3.7. Total bacterial count of pickled brines

Total bacterial count (TBC) of pickled caper buds and fruits brines during storage period at temperature for 1st, 2nd and 3rd month was examined and the results are presented in Fig. (6).



Bads[1], Fruits[1] (1st month) Bads[2], Fruits[2] (2nd month) Bads[3], Fruits[3] (3rd month)

Fig. 6: Total bacterial count (cfux 103 /g) of pickled caper buds and fruits brines during 3 months of storage.

The obtained data in Fig. (6), illustrated obviously that, there was significantly ($P<0.05$) decrease in total bacterial counts by increasing the concentration of the salt for pickled caper buds brines after one month .While,T2 for the pickled caper fruits brine had the lowest value($0.5x10^3$cfu /g) at1st month**.**

All studied treatments of brines pickled caper buds and fruits recorded an increase in the total bacterial count during storage at room temperature for 1st ,2nd and 3rd month. Increasing the concentration of the salt solutions led to decrease the total bacteria count for buds brinesandT4 was the lowest values after1st month of pickling for buds comparing with the other treatments. Meanwhile, the highest increment ($12x10^3$ and$14x10^3$ cfu /g) were recorded for T4 pickled caper buds and fruits brines respectively, at the end of storage.

Belviranl *et al.* (2016) reported that the fruits of caper were fermented in three different brines (5 %, 10 % and 15 %) for a month, and storage for nine months. The highest lactic acid bacteria growth was seen in brines of 5 %, growth is lower in brines of 10 % and increasing salt ratio negatively affected lactic acid bacteria growth. However, brines of 15 % are more safety with respect to growth of some unwanted microorganisms such as yeast-mould. Sánchez *et al.,* (1992) found that the use of brine at a high concentration in pickling inhibits lactic acid bacteria (LAB) growth, low concentration brines lead to microorganism growth and high acidity.

3.8. Sensory evaluation of pickled caper

Sensory attributes of pickled caper buds and fruits was determined during storage period for 1st ,2nd and 3rd month are and the obtained results were tabulated in Table (4).

From Table (4), it could be noticed that sensory attributes of pickled caper buds and fruits during storage received a mean score higher than (6.00) and less than (8.24) which ranged between " Like Slightly, Like Moderately and Like Very Much "and indicated good acceptance.

The sensory attributes score for taste, odor, texture, colour, appearance and overall acceptability were significantly ($p<0.05$) differences for all pickled caper treatments with different solutions during the storage period. Pickled caper fruits were the most accepted by panelists with the highest scores for all sensory properties comparing with pickled caper buds during all stages of storage which equals to "Like very Much" the product.

Table 4: Sensory evaluation of pickled caper buds and fruits during storage for3 months.

Properties	Buds	Fruits	Buds	Fruits	Buds	Fruits	Buds	Fruits
	T1		T2		T3		T4	
				After one month				
Taste	7.16^{c}	7.83^{a}	7.16^{c}	7.83^{a}	7.07^{d}	7.34^{b}	7.16^{c}	7.02^{e}
0der	7.25^{d}	7.79^{a}	7.47^{b}	7.78^{a}	7.43^{c}	7.65^{ab}	7.00^{e}	7.70^{a}
texture	7.56^{b}	8.10^{a}	7.61^{b}	8.01^{a}	7.43^{c}	8.01^{a}	7.25^{d}	7.61^{b}
Color	7.70^{d}	8.24^{a}	7.79^{c}	8.24^{a}	7.56^{e}	8.10^{b}	7.43^{f}	7.70^{d}
Appearance	6.89^{f}	8.24^{a}	7.83^{b}	7.20^{e}	7.61^{c}	8.06^{b}	7.47^{d}	7.52^{cd}
Acceptability	7.43^{bc}	7.83^{a}	7.52^{b}	7.83^{a}	7.43^{bc}	7.91^{a}	7.38^{c}	7.56^{b}
				After two month				
Taste	6.98^{c}	6.84^{d}	7.16^{a}	6.93^{c}	7.02^{b}	6.76^{de}	6.71^{e}	7.02^{b}
0der	7.38^{c}	7.20^{d}	6.75^{g}	7.27^{d}	7.83^{a}	7.56^{b}	6.98^{f}	7.11^{e}
texture	7.16^{d}	7.65^{a}	7.47^{bc}	7.38^{c}	7.38^{c}	7.47^{bc}	6.84^{e}	7.52^{b}
Color	7.20^{d}	7.83^{a}	7.38^{c}	7.38^{c}	7.61^{b}	7.56^{b}	6.93^{e}	7.16^{d}
Appearance	7.29^{cd}	7.65^{a}	7.11^{e}	7.34^{c}	7.20^{d}	7.56^{b}	6.89^{f}	7.52^{b}
Acceptability	7.25^{d}	7.65^{a}	7.25^{d}	7.52^{b}	7.38c	7.45^{bc}	6.89^{e}	7.02^{f}
				After three month				
Taste	6.23^{f}	7.20^{c}	6.00^{g}	7.92^{a}	6.53^{d}	7.20^{c}	6.30^{e}	7.35^{b}
0der	6.92^{c}	6.90^{c}	6.23^{e}	7.20^{b}	6.66^{d}	7.43^{a}	6.90^{c}	7.27^{b}
Texture	7.05^{f}	7.80^{c}	7.13^{ef}	7.50^{d}	8.98^{a}	8.10^{b}	7.20^{e}	7.80^{c}
Color	7.50^{b}	7.95^{a}	6.98^{e}	7.35^{d}	7.43^{cd}	7.35^{d}	7.50^{b}	6.90^{e}
Appearance	7.58^{d}	7.95^{b}	7.58^{d}	8.25^{a}	7.80^{c}	7.80^{c}	7.50^{d}	8.35^{a}
Acceptability	6.68^{d}	7.20^{b}	6.90^{c}	7.48^{a}	6.98^{c}	7.20^{b}	6.9^{c}	6.68^{d}

Values bearing the same small letter within the same row are not significantly different ($P > 0.05$) for each parameter

Conclusions

From the previous results, it could be noticed that produced pickles of caper fruits and buds by using pickling brines (5 %, 8 % and 10 %) and dry salt were important source of total polyphenols and flavonoids. According to the results of total bacteria count, increasing the concentration of the salt solutions led to decrease the total bacteria count for buds brines andT4 recorded the lowest value after1st month of pickling for buds comparing with the other treatments. The results of sensory analysis, showed that pickled caper fruits were the most accepted by panelists with the highest scores for all sensory properties comparing with pickled caper buds during all stages of storage which equals to "Like very Much" the product.

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