Uluslararası Tarım Araştırmalarında Yenilikçi Yaklaşımlar Dergisi
International Journal of Innovative Approaches in Agricultural Research 2021, Vol. 5 (3), 290-302
https://doi.org/10.29329/ijiaar.2021.378.4

Original article

Chemical, Microbiological and Sensory Properties of Acur (Cucumis Melo Var. Flexuosus) Pickles Produced Using Salt and Vinegar at Different Concentrations

Yekta Gezginç [a, *] & Özge İnanç [b]

[a] Dept. of Food Engineering, Faculty of Engineering and Architecture, University of Kahramanmaraş Sütçü İmam, Kahramanmaraş, Turkey
[a] Dept. of Food Engineering, Graduate School of Natural and Applied Sciences, University of Kahramanmaraş Sütçü İmam, Kahramanmaraş, Turkey

Abstract

In this research, it was aimed to determine some chemical, microbiological and sensory properties of acur pickles and to compare them with Turkish Standards and determine their differences. Chemical analyzes were determined pH of the acur pickle 3.27-3.99, salt 2.85-8.15%, titration acidity 0.51-0.97%, dry matter 4.80-8.35%, vitamin C 4.15-6.81 mg/100mL, lactic acid 0.229-0.530 mg/mL, acetic acid 0.137-0.256 mg/mL, propionic acid 0.027-0.085 mg/mL; total mesophilic aerobic bacteria 1.1x102-3.5x102 cfu /mL, lactic acid bacteria 0.1x105-3.8x105 cfu / mL and yeast, 1.0x104-6.5x104 cfu / mL. It was determined that all acur pickles obtained were in conformity with TS 11112 standard.

Keywords: Traditional acur pickle, *Cucumis Melo Var. Flexuosus*, fermentation, lactic acid.

Received: 31 August 2021 * **Accepted:** 29 September 2021 * **DOI:** https://doi.org/10.29329/ijiaar.2021.378.4

* **Corresponding author:**

Gezginç Yekta is an associate professor in the Department of Food Engineering at Kahramanmaraş Sütçü İmam University in Kahramanmaraş. Her research interests include the Food Biotechnology, Microbial Genetics, Food fermentation. She lives, works and studies in Kahramanmaraş, Turkey.
Email: yektagezginc@gmail.com

INTRODUCTION

Fermentation is one of the oldest methods of preserving foods with the activity of natural flora in raw material dating back thousands of years (Nout, 2001; Ross et al., 2002; Li, 2004; Hutkins, 2006). Historically, food fermentation is described as a process that occurs in raw material along with the activity of natural flora. The most commonly fermented fruits and vegetables are cabbage, cucumber, carrot, eggplant, pepper, tomato, olives and beans (Aktan et al., 1999; Ova, 2002). Pickles can sometimes be named as a general term for all vegetables and fruits that are preserved by fermentation or direct preservation or acidification. Traditionally fermented pickles are usually home-made products obtained through spontaneous fermentation (Behera et al., 2020). Adittionaly pickle production can be related to the amount of vegetables grown in the region or the palate and consumption taste of the people in that region. One of these vegetables, the acur (Cucumis melo var. flexuosus) plant, is grown in the provinces of Kahramanmaraş and Adana in the Mediterranean region, and in some provinces of the Aegean region, as well as the Southeastern Anatolia region in Turkey. In general, acur, which has a thin, long and curled structure, is widely consumed like cucumber (Robinson and Decker-Walters, 1997). Acur, which is also produced known as "hitta" and "hitti". However, despite the widespread cultivation of acur, it is observed that not much research has been done (Çaglar et al., 2004). Pickles, which are produced by the enzymes formed by the microorganisms during the fermentation, provide an increase in consumption appeal in terms of taste, smell and appearance, inhibition of unwanted microorganisms, improvement of product quality, increase in nutritional value and digestibility (John et al., 2007). Especially due to the increase in consumers' demand for natural and additive-free products, lactic acid bacteria (LAB) increase their importance as a potential food preservative. In addition, organic acids formed as a result of fermentation are of great importance in terms of both preventing the deterioration of the product and being functional compounds for health.

The aim of study covers the production of traditionally pickled acur made under laboratory conditions at different salt and vinegar concentrations and determination of chemical, microbiological and sensory properties. It is aimed to determine the most suitable product for the taste of the consumer and to increase the consumption of acur pickles.

MATERIALS and METHODS

Material

As raw material acur (*Cucumis melo var. Flexuosus*), ranging from 2 to 4 cm in diameter and 10 to 15 cm in length, was procured from the local market. Biosalt branded rock salt and Kemal Kükrer branded grape vinegar were used in the production of pickles.

Method

Acur pickles were prepared in 0.5 L sterile glass jars in a laboratory environment in three replications with different brine and different grape vinegar ratios (traditional production method) and fermented for 21 days between 18-20 ^{0}C and then turned into pickles (Figure 1). Commercially sold Evce brand traditional acur pickles were produced with grape juice, vinegar, salt, flavoring natural herbs in barrels were analyzed directly as a control group. The acur pickles was prepared in the laboratory. The acur pickles and brine were homogenized together and analyzed.

Acur Pickle Production

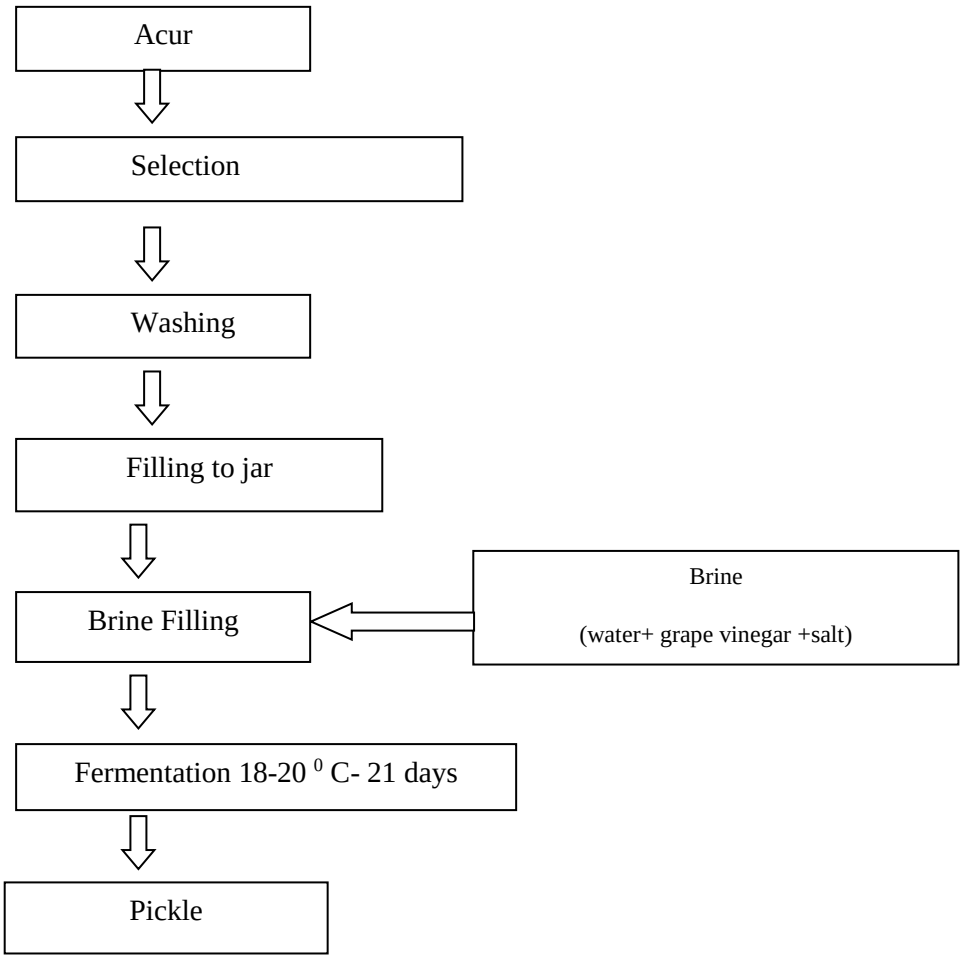

Figure 1. Traditional pickle production steps

Acur was prepared in 3 replications in different brine and different ratios of grape vinegar, fermented at 18-20 ^{0}C for 21 days and then turned into pickles. Traditional acur pickles produced for commercial purposes were directly analyzed as a control group. The salt and grape vinegar ratios of the prepared pickles are given in Table 1.

Table 1. Sample of acur pickles prepared with different salt and grape vinegar

Sample Number	Salt Concentration %	Vinegar Concentration %
1	6	0
2	8	0
3	10	0
4	12	0
5	10	10
6	10	20
7	10	30
8	6	10
9	6	20
10	6	30
Control	-	-

Chemical Analysis

The pH values of the brines were measured with an Orion 3-star pH portable brand pH meter at 20 ºC. The salt content was determined by titration with 0.1 M $AgNO_3$ in the presence of 5 potassium chromate indicator, based on the Mohr method and results are given in g NaCl/100 mL (Anonymous, 1993). Titration acidity in brine samples was determined with 0.1 M NaOH solution in the presence of phenolphthalein indicator (0.1% g/mL) and expressed as g lactic acid/100 mL (Anonymous, 2004). Dry matter was determined as a value of % (Anonymous, 2001). On the other hand, ascorbic acid content was identified as mg/100 mL (Sakar and Tanker, 1991). For the analysis of organic acis, SPD-M20A diode array detector, for analysis of organic acids, two-channel gradient pump (Shimadzu LC-10AT), auto sampler (SIL 20AC), colon oven (CTO-20AC), FCV-11AL wave unit communication bus module (CBM-20A) Shimadzu Prominence HPLC (Shimadzu, Kyoto, Japan) were utilized. Analysis was carried out in Intersil ODS3, 5 µm diameter 4.6 mm x 250 mm long column, 0.5% metaphosphoric acid carrier phase with a flow rate of 0.6 mL/min. The samples were extracted with 1% metaphosphoric acid solution (Gezginç et al., 2015).

Microbiological Analysis

Total mesophilic aerobic bacteria count was performed in brine samples on Plate Count Agar (PCA) medium, incubated at 28-30 °C for 48 hours. Total LAB count and total yeast-mold count were determined on De Man-Rogosa-Sharpe (MRS) Agar medium, incubated at 30 °C for 48 hours and on Potato Dextrose Agar (PDA) medium at 28-30 °C for 72 hours using the cultural count method

respsctively. Colony counts were repeated three times per sample and results were expressed as logcfu/mL (Halkman, 2005).

Sensory Analysis

In the sensory analysis, a scoring test was performed out of 1 to 5 points in order to evaluate 11 pickles in terms of color, texture, flavor, aroma, smell and general appearance on the 1st and 21st storage days. Sensory analysis was carried out with the participation of 10 panelists (Food Engineers, dieticians, doctors, students and cooks). The examples were coded and presented to the panelists.

Statistical Analysis

In this study, the data related to the chemical and organic acid analysis results were analyzed with the SPSS (version 20) program; differences were detected by the Tukey test. The analysis results obtained were evaluated and interpreted at the 0.05 and 0.01 significance levels (Yıldız and Bircan, 2003). Results were presented as mean and ±standart deviation.

RESULTS and DISCUSSION

Ten acur Acur pickles samples were made using the traditional way with ten distinct formulations, and one was made in the industry using the conventional approach as control. The findings obtained as a result of the three replication analyzes and sensory evaluations performed on the first day of the fermentation process that lasted for 3 weeks and on the twenty-first storage days after three weeks are given below, respectively, based on the comments, and statistically evaluated.

Chemical Analysis

It is seen that the results of pH analysis in the brine of the acur pickle samples ranged from 3.52 (Sample 5) to 3.99 (Sample 7) on the first day of fermentation, and between 3.27 (Sample 1) and 3.87 (Sample 7) on the twenty-first day. As for control group, this change was observed a pH value varied from 3.40 to 3.36 (Table 2). Some studies have shown that the pH of cucumber pickles may reflect changes to greater or smaller degree. In a similar study conducted by Ozcelik et al. (1999), in a similar study by 18 different pickled cucumber pH values were found to be between 3.39 and 4.35. Özçelik and İç (2000), in their study of pickled cucumbers, determined the pH values between 3.43 and 3.95. According to the results of the analysis of variance in this study, the data obtained on the 1st and 21st days according to the pH values of the pickles with different salt and vinegar concentrations were found to be statistically significant ($p<0.01$).

Table 2. Mean and standard deviation values of the pH, Total Acidity (%), Salt (%) and Dry Matter (%) of brine samples for during fermentation

Sample No	pH		Total Acidity (%)		Salt (%)		Dry Matter (%)	
	Day							
	1	21	1	21	1	21	1	21
1	3.59±0.41^{bcd}	3.27±0.27^{c}	0.53±0.01^{c}	0.56±0.05^{bc}	3.10±0.20^{e}	3.45±0.05^{f}	4.85±0.05^{c}	5.10±0.20^{bc}
2	3.56±0.01^{bcd}	3.52±0.01^{abc}	0.56±0.01^{c}	0.65±0.01^{bc}	4.75±0.25^{d}	5.15±0.05^{c}	7.50±0.40^{ab}	7.25±0.55^{b}
3	3.88±0.24^{ab}	3.81±0.30^{a}	0.53±0.01^{c}	0.58±0.06^{bc}	6.75±0.05^{b}	7.30±0.30^{b}	7.40±0.30^{ab}	7.45±0.15^{ab}
4	3.76±0.15^{abcd}	3.66±0.12^{abc}	0.51±0.01^{c}	0.54±0.01^{c}	7.25±0.15^{a}	8.15±0.05^{a}	8.15±0.05^{a}	8.35±0.25^{a}
5	3.52±0.02^{bcd}	3.43±0.01^{bc}	0.53±0.01^{c}	0.57±0.05^{bc}	5.30±0.10^{c}	5.35±0.05^{d}	7.05±0.15^{b}	7.00±0.10^{b}
6	3.83±0.23^{abcd}	3.50±0.05^{abc}	0.70±0.01^{b}	0.75±0.05^{b}	5.55±0.15^{d}	5.65±0.10^{d}	7.40±0.30^{ab}	7.45±0.05^{ab}
7	3.99±0.01^{ab}	3.87±0.03^{a}	0.81±0.01^{b}	0.85±0.01^{b}	5.85±0.05^{d}	5.90±0.20^{de}	7.70±0.60^{ab}	7.20±0.20^{b}
8	3.55±0.09^{bcd}	3.49±0.02^{abc}	0.53±0.01^{c}	0.63±0.01^{bc}	2.85±0.05^{e}	3.25±0.05^{f}	4.80±0.06^{c}	4.95±0.25^{bc}
9	3.66±0.00^{abcd}	3.57±0.09^{abc}	0.72±0.01^{b}	0.74±0.01^{b}	3.00±0.10^{e}	3.20±0.10^{f}	5.00±0.10^{c}	5.05±0.45^{bc}
10	3.91±0.01^{ab}	3.83±0.03^{a}	0.87±0.01^{a}	0.97±0.01^{a}	3.25±0.05^{e}	3.45±0.05^{f}	5.35±0.15^{c}	5.05±0.05^{bc}
control	3.40 ±0.20^{bcd}	3. 36±0.10^{c}	0.90±0.14^{a}	1.00±0.28^{a}	4.70±0.20^{d}	4.90±0.10^{e}	6.80±0.14^{ab}	7.55±0.14^{ab}

The results of the titration acidity analysis of the pickle samples were revealed that Sample 4 had the lowest (0.51%) while the highest value was presented by Sample 10 (0.87%) on the 1st day, it ranged from 0.54% (Sample 4) to 0.97% (Sample 10) on day 21 storage of fermentation. Control pickles were 0.90% in the 1st day of storage, a titration acidity of 1.0% was found on day 21 of fermentation (Table 2). Total acidity (in terms of lactic acid or acetic acid) in % was determined as 0.5 to 2 in cucumber pickles according to TS 11112/April 2015. In a previous study conducted by Özcelik et al. (1998) it was reported that acidity values ranged between 0.29% and 1.58% in cucumber pickles as a result of the analyzes they carried out during the fermentation period. Similarly, Özçelik and Ulu (2002) reported that the acidity values varied between 0.82% and 1.64% in cucumber pickles. It was determined that as the vinegar ratio in the pickle groups increased, the acidity ratio increased and the fermentation times did not affect the acidity in the brine ($p<0.01$).

The salt content of the pickle samples varied between 2.85% (Sample 8) and 7.25% (Sample 4) on the first day, and between 3.20% (Sample 9) and 8.15% (Sample 4) on the twenty-first day. These diversified findings were initially due to the salt content added to the brine. According to TS 11112/April 2015, it is stated that the amount of salt in cucumber pickles should not be more than 6%. Salt content of the control sample changed from 4.70% on the 1st day and 4.90% on the 21st day (Table 2). Fermentation times did not affect the salt content of the brines much. According to salt values (%) of

acur pickles, the data obtained on the 1st and 21st days were found to be statistically significant ($p<0.01$). In the study conducted by Uylaşer and Erdem (2004), salt amounts in cucumber pickles produced using 6 different formulations and production techniques did not show much variation during the storage period. Similarly, Özçelik and Ulu (2002) reported that salt concentrations in acur pickles were varied between 4.08% and 4.32% in the first storage, and between 4.06% and 4.28% in the 21st day storage.

The dry matter content varied between 4.80% (Sample 4) and 8.15% (Sample 8) in the 1st day of storage, and between 4.95% (Sample 8) and 8.35% (Sample 4) in the 21st day of fermentation. The control sample pickled acur exhibited 6.80% dry matter in the 1st day and 7.55% in the 21st day of fermentation. The variance analysis results of the % Dry matter values on the 1st and 21st days of storage of pickled acur are given in Table 2. According to % dry matter values, the data obtained on the 1st and 21st days were found to be statistically significant ($p<0.01$). As a result of the dry matter analysis performed on 10 pickled pickles and control samples produced by the traditional method in different formulations. Dry matter content was found to be between 4.80% and 8.35%. In their study, Uylaşer and Erdem (2004) found the dry matter content in cucumber pickles to be between 5.75% and 7.40%. The findings are in parallel with these studies. In another study, Akbudak and Özer (2003) found the dry matter amounts in pickles made with different cucumber varieties between 3.30% and 7.87%. While some of the obtained results are in parallel with the dry matter results in this study, the other part is lower than the results found. This may be due to the type of cucumber used.

Table 3. Vitamin C, Lactic Acid, Acetic Acid, Propionic Acid of brine samples for during fermentation

	Ascorbic acid (mg/100mL)		**Lactic acid (mg/mL)**		**Acetic acid (mg/mL)**		**Propionic acid (mg/mL)**	
	Day							
Sample No	**1**	**21**	**1**	**21**	**1**	**21**	**1**	**21**
1	6.81±0.18^{a}	6.55±0.05^{a}	0.333±0.01^{cd}	0.473±0.01^{b}	0.137±0.01^{e}	0.146±0.00^{d}	0.050±0.00^{c}	0.055±0.01^{cd}
2	5.50±0.19^{b}	5.30±0.10^{b}	0.318±0.02^{cd}	0.463±0.01^{b}	0.140±0.01^{e}	0.140±0.01^{d}	0.033±0.07^{d}	0.039±0.04^{d}
3	5.91±0.18^{b}	5.80±0.20^{b}	0.500±0.00^{a}	0.511±0.01^{a}	0.143±0.00^{e}	0.168±0.01^{cd}	0.064±0.01^{b}	0.078±0.04^{a}
4	6.53±0.18^{a}	6.35±0.05^{a}	0.284±0.01^{e}	0.338±0.01^{de}	0.175±0.00^{cd}	0.192±0.00^{c}	0.034±0.01^{d}	0.036±0.01^{d}
5	6.34±0.18^{a}	5.70±0.30^{b}	0.510±0.01^{a}	0.512±0.01^{a}	0.229±0.01^{b}	0.238±0.01^{b}	0.081±0.00^{a}	0.085±0.01^{a}
6	5.08±0.37^{cd}	4.90±0.30^{de}	0.350±0.01^{cd}	0.431±0.03^{cd}	0.164±0.01^{cde}	0.158±0.02^{d}	0.070±0.05^{a}	0.075±0.01^{c}
7	4.35±0.01^{cd}	4.15±0.05^{de}	0.289±0.00^{e}	0.332±0.01^{de}	0.179±0.01^{cd}	0.205±0.01^{c}	0.060±0.03^{b}	0.060±0.01^{c}
8	6.71±0.19^{a}	6.55±0.05^{a}	0.275±0.01^{e}	0.381±0.01^{cd}	0.160±0.02^{cde}	0.167±0.01^{cd}	0.029±0.01^{d}	0.033±0.01^{d}
9	5.26±0.18^{b}	5.20±0.20^{b}	0.383±0.01^{cd}	0.518±0.02^{a}	0.229±0.02^{b}	0.242±0.01^{b}	0.048±0.01^{c}	0.054±0.01^{cd}
10	4.53±0.18^{cd}	4.35±0.15^{de}	0.229±0.00^{cd}	0.530±0.02^{a}	0.254±0.02^{a}	0.256±0.01^{a}	0.027±0.01^{d}	0.036±0.01^{d}
Control	4.00±0.20^{de}	3.98±0.10^{cd}	0.274±0.01^{e}	0.278±0.01^{e}	0.157±0.01^{cde}	0.159±0.01^{c}	0.080±0.01^{a}	0.081±0.00^{a}

The results of ascorbic acid (vitamin C) content analyzes ranged from 4.35 (Sample 7) to 6.81 mg/100mL (Sample 1) in the 1st day of fermentation, and between 4.35 (Sample 10) and 6.55 mg/100mL (Sample 1 and 8) in the 21st day of fermentation. Additionaly, the control sample of pickled acur, contained 4.00 mg/100mL of ascorbic acid on the 1st day and 3.98 mg/100mL in the 21st day of fermentation (Table 3). It is seen that as the ascorbic acid values decreased on the 21st day of fermentation. Acccording to ascorbic acid values, the data obtained on the 1st and 21st days were found to be statistically significant ($p<0.01$). In a previous study conducted by Güvenç (2016), it was reported that vitamin C in acur fruit contains 8.7 mg/100g. Similarly, Güven et al. (2003) reported that vitamin C values in industrial sauerkraut were varied between 9.6 to 16.8 mg/100mL, after 5 months of storage in the pickles they produced with different types of cabbage from different regions. The vitamin C value determined in this study showed agreement with the value of the acur plant at the beginning. According to the study on sauerkraut, the initial vitamin C value decreased during storage. As seen in the results in this study, a decrease in vitamin C values was observed. The fact that the vitamin C value in sauerkraut is higher than that of pickles may be due to the fact that pickle materials (cabbage and acurd) are plants with different compositions.

According to the results of the organic acid analysis of the acur pickle samples; lactic acid was found to range from 0.229 mg/mL (Sample 10) to 0.510 mg/mL(Sample 5) on fermentation day 1, and 0.332 mg/mL (Sample 7) to 0.530 mg/mL (Sample 10) on fermentation day 21(Table 3). According to the lactic acid values, the data obtained on the 1st and 21st days were statistically significant ($p<0.01$).

The results of the acetic acid analysis of the pickle samples were revealed that Sample 1 had the lowest (0.137 mg/mL) while the highest value was presented by Sample 10 (0.254 mg/mL) on the 1st day, it ranged from 0.140 mg/mL (Sample 2) to 0.256mg/mL (Sample 10) on day 21 storage of fermentation. According to the acetic acid values, the data obtained on the 1st and 21st days were statistically significant ($p<0.01$).

Propionic acid was found to be between 0.027 mg/mL and 0.081 mg/mL on the 1st storage day, and between 0.033 mg/mL and 0.085 mg/mL on the 21st storage day. On the other hand, 0.274 mg/mL to 0.278 mg/mL lactic acid, 0.157 mg/mL to 0.159 mg/mL acetic acid, and 0.080 mg/mL to 0.081 mg/mL propionic acid were determined in pickled acur commercially. According to the propionic acid values, the data obtained on the 1st and 21st days were statistically significant ($p<0.01$).

As the number of lactic acid bacteria increases during the fermentation period, the amount of organic acid also increases. Ji et al. (2013) determined the amount of lactic acid as 0.240mg/mL on the 1st day and 3.772 mg/mL on the 7th day, while they determined the amount of acetic acid as 0.207mg/mL on the 1st day and 3.206 mg/mL on the 7th day. Our study was compatible with this study, and the low amount of lactic acid and acetic acid on the 21st day is due to the decrease in LAB and organic acid amounts when the fermentation period is over. Shinagawa et al. (1996) found lactic acid as 0.85 mg/mL,

acetic acid as 0.25 mg/mL, and propionic acid as 0.05 mg/mL in their study. Likewise, the organic acid values in these studies showed conformity with the values we found.

Microbiological Analysis

In this study, the number of LAB was found to be in the range of $0.1x10^5$-$3.8x10^5$ cfu/mL, and $<10^1$ in the industrially made control sample, pickled acur (Table 4). The very low number of this number can be attributed to the industrial phase and multiple processing and heat treatment. Özçelik and Ulu (2002) ranged the LAB number from $7.4x10^4$ to $1.2x10^5$ cfu/mL in their study, Özçelik and İç (1999) between $2.16x10^5$ and $1.5x10^6$ cfu/mL, Guillou et al. (1994), Guillou and Floros (1993), Etchells et al. (1992) found it in the range of 10^4 to 10^5 cfu/mL. These results were generally consistent with our study.

Table 4. Number of Lactic Acid Bacteria, Yeast, Mesophilic Aerobic Bacteria

	Lactic Acid Bacteria (cfu/mL)		**Yeast (cfu/mL)**		**Mesophilic aerobic bacteria (cfu/mL)**	
	Day					
Sample No	**1**	**21**	**1**	**21**	**1**	**21**
1	$2.5x10^5$	$2.7x10^5$	$2.3x10^4$	$2.8x10^4$	$1.3x10^2$	$1.6x10^2$
2	$3.4x10^5$	$3.8x10^5$	$1.3x10^4$	$6.5x10^4$	$1.1x10^2$	$1.5x10^2$
3	$2.9x10^5$	$3.1x10^5$	$4.0x10^4$	$4.4x10^4$	$2.3x10^2$	$3.5x10^2$
4	$0.2x10^5$	$0.3x10^5$	$1.5x10^4$	$2.0x10^4$	$1.4x10^2$	$1.6x10^2$
5	$0.4x10^5$	$0.6x10^5$	$1.7x10^4$	$3.7x10^4$	$2.5x10^2$	$3.1x10^2$
6	$1.9x10^5$	$1.9x10^5$	$2.1x10^4$	$2.8x10^4$	$2.1x10^2$	$2.5x10^2$
7	$0.1x10^5$	$0.3x10^5$	$1.9x10^4$	$2.3x104^5$	$1.5x10^2$	$1.6x10^2$
8	$1.5x10^5$	$3.0x10^5$	$1.7x10^4$	$2.3x10^4$	$2.5x10^2$	$2.7x10^2$
9	$2.3x10^5$	$2.4x10^5$	$4.3x10^4$	$5.2x10^4$	$1.8x10^2$	$2.0x10^2$
10	$0.2\ x10^5$	$0.3x10^5$	$1.0x10^4$	$1.0x10^4$	$1.8x10^2$	$2.1x10^2$
Control	$<10^1$	$<10^1$	$<10^1$	$<10^1$	$<10^2$	$<10^2$

Yeast counts ranged from 1.0x104 to 4.3x104 cfu/mL on the 1st fermentation day, and between 1.0x104 and 6.5x104 cfu/mL on the 21st fermentation day. Yeast amount was not found in the control sample pickled acur (Table 4). The number of yeast determined during fermentation was determined between 3.8x104 and 4.5x105 cfu/mL in the study by İç et al., (1998) and was similar to our study. As a result of the decrease in the pH value during the fermentation, they used the sugars that the lactic acid bacteria could not use and showed improvement and there was no significant increase at the end of the 21^{st} day.

In the study, the total amount of mesophilic aerobic bacteria ranged from $1.1x10^2$ to $2.5x10^2$ cfu/mL on the 1st fermentation day, and between $1.5x10^2$ and $3.5x10^2$ cfu/mL on the 21st fermentation day. Total mesophilic aerobic bacteria could not be detected as the control sample was pasteurized with pickled acur (Table 4). Ozcelik et al. (1999) found the number of mesophilic aerobic bacteria in cucumber pickles in the range of $1.28x10^4$ to $1.63x10^6$ cfu/mL. Ozcelik et al. (1998) found it in the range of $1.43x10^4$ to $1.86x10^7$ cfu/mL as a result of 1^{st} and 21^{st} days of storage. The reason for the very low

amount of total mesophilic aerobic bacteria in the study can be attributed to the use of boiled water, well-washed acurs and sterilized jars in the laboratory condition.

Sensory Analysis

Sensory Properties of acur pickles have an important impact on consumer acceptability. Sensory properties of pickle samples are given figure 2. In terms of color, texture, flavor, aroma, smell and general appearance of 11 acur pickles, pickles 3 and 7 received the highest score in terms of general appearance, color, texture, flavor, aroma and smell of the average sensory evaluation results of 10 panelists. Although the industrial-based control sample pickles were not liked very much, the pickles with the least appreciation were the pickles numbered 2 and 4. Pickles 3 and 7 received the highest general appreciation on the 21st fermetation day. Although the industrial-based control sample pickles were not liked very much, pickles 2, 4 and 8 were the pickles with the least appreciation (Figure 2 and 3).

In the study conducted by Cingöz (2005), home-made cucumber pickles were more popular than industrially made pickles; stated that there is no difference between the two in terms of color, texture and general appearance. The fact that the pickled pickles, which we traditionally make in the laboratory, are more liked sensory than the control sample made industrially, is in accordance with this study.

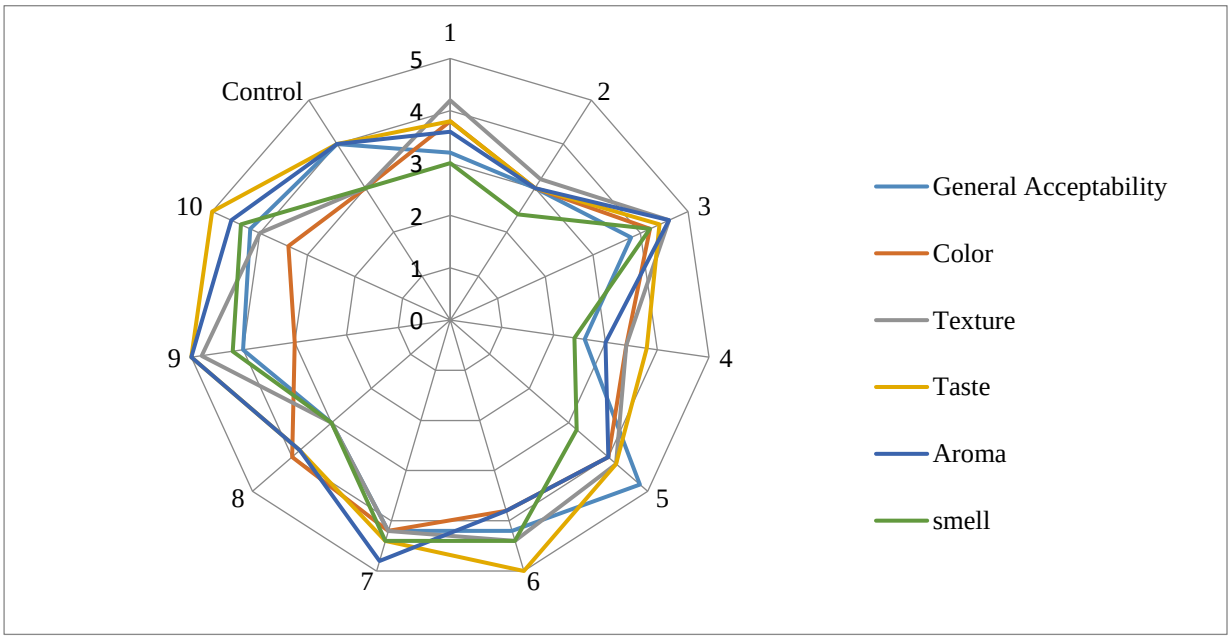

Figure 2. Sensory evaluation of acur pickles on 1st day of fermentation

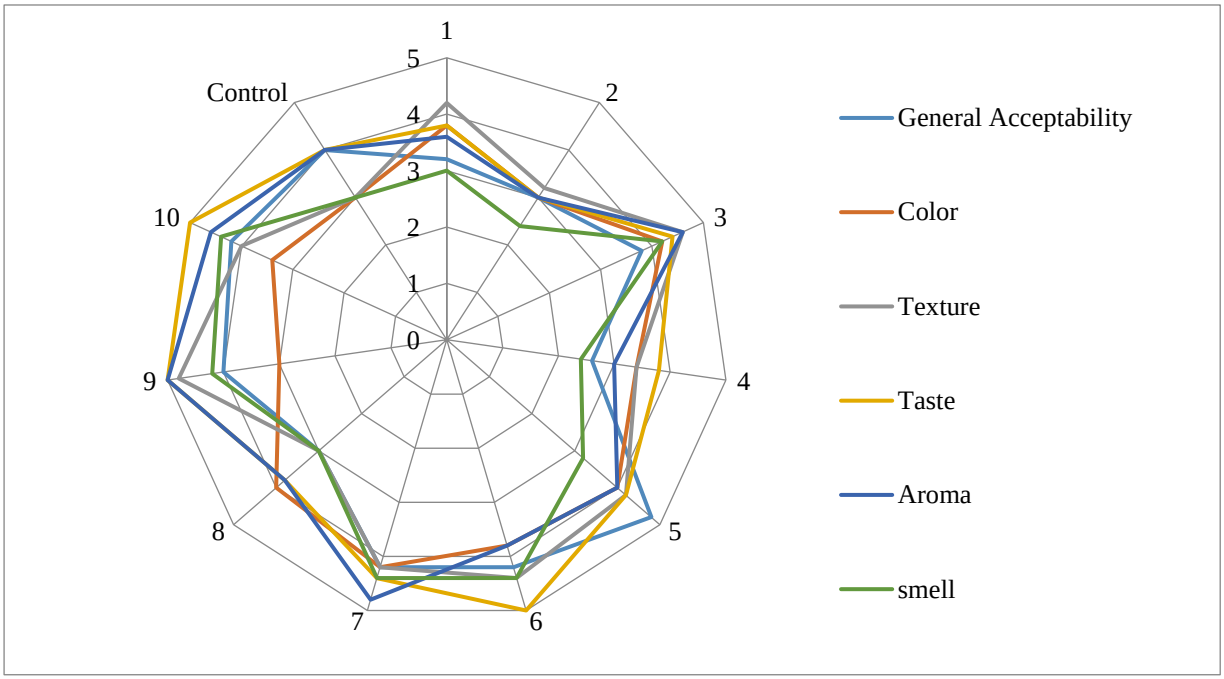

Figure 3. Sensory evaluation of acur pickles on 21st day of fermentation

CONCLUSION

To establish a production standard for pickle samples, which are produced with different salt and vinegar concentrations, and pickles produced in industry. This study is aimed to create preliminary information for a TSE standard in the future. The most successful sample was the 3rd sample with 10 % salt-0 % vinegar. This was followed by Sample 7, with 10 % salt-30 % vinegar. When these studies and consumer taste are examined, it is seen that pickles not only as a regional and traditional product, but also in the industry, will bring richness to the food sector. In addition, the industrial production to be made can serve as a reference for both the expansion of acur production areas and the opening of a separate business area. In conclusion, it is predicted that this study will be a reference for acur pickles to get rid of traditional production and move to an industrial production size more intensively, as well as to develop the production standard.

Acknowledgement

This study was supported by Kahramanmaraş Sütçü İmam University, Scientific Research Council for financial support (Project No: 2016/5-18 YLS).

REFERENCES

Akbudak, Ö. & Özer, M.H. (2003). Farklı Sıcaklıklarda Muhafaza Edilen Hıyarlarda Meydana Gelen Fiziksel ve Kimyasal Değişimler. *Uludağ Üniv. Zir. Fak. Derg*., 17(1):33-46.

Aktan, N., Kalkan, H. & Yücel, U. (1999). Turşu Teknolojisi, Ege Üniversitesi Ege Meslek Yüksekokulu Yayınları, No:23, 148s, İzmir.

Anonymous, (1993). Hıyar Turşusu Standardı. TS 11112. 13 sayfa, TSE, Ankara.

Anonymous, (2001). Tahıl ve Tahıl Ürünleri- Rutubet Muhtevasının Tayini Rutin Referans Metot (TS 1135 ISO 712), Türk Standartları Enstitüsü, Ankara.

Anonymous, (2004). Standart Methods for Examination of Dairy Products (Apha) 15.051/2004

Behera, S.S., El Sheikha, A. F., Hammami, R & Kumar, A. (2020). Traditionally fermented pickles: How the microbial diversity associated with their nutritional and health benefits? *Journal of Functional Foods, 70*, 1-21

Cingöz E. (2005). Samsun'da Tüketilen Hıyar Turşularının Bileşimi. Ondokuz Mayıs Üniversitesi, Gıda Mühendisliği Ana Bilim Dalı Yüksek Lisans Tezi, Samsun. s50-52.

Caglar, G., Kösetürkmen, N., Yarımoglu, Örs, M & Ergün, Ö. (2004). Farklı acur (*Cucumis melo* var. *flexuosus* Naud.) genotiplerinde partenokarpik meyve tutumu özelligi üzerine arastırmalar. Türkiye V. Sebze Tarımı Sempozyumu Bildirileri, 21-24 Eylül 2004, Çanakkale, 269-272.

Etchells, J. L., Fleming, H. P & Bell, T. A. (1992). Factors influencing the growthof lactic acid bacteria during the fermentationof brined cucumbers. *In*: Lactic Acid Bacteria in Beverages and Food (eds. Carr, J. G., Cutting, C. V., and Whiting, G. C.). Academic Press, London. pp. 281–305.

Gezginc, Y., Topcal, F., Comertpay, S., & Akyol, I. (2015). Quantitative analysis of the lactic acid and acetaldehyde produced by Streptococcus thermophilus and Lactobacillus bulgaricus strains isolated from traditional Turkish yogurts using HPLC. *Journal of dairy science*, *98*(3), 1426-1434.

Guillou, A.A & Floros, J.D. (1993). Multiresponse Optimization Minimizes Salt İn Natural Cucumber Fermentation and Storage. *Journal of Food Science,* 58(6),1381-1389.

Guillou, A.A., Floros, J.D & Cousin, M.A, (1994). Calcium chloride and potassium sorbate reduce sodium chloride used during natural cucumber fermentation and storage. *Journal Food Science,* 57(6):1364-1368.

Güven, S., Başaran, M & Erüstün, G., (2003). Endüstri Tipi Lahana Turşusu Üretimi Üzerinde Araştırma. Gıda 2003, Yıl:8, Sayı:5.

Güvenç, İ. (2016). Sebzecilik Temel Bilgiler Muhafaza ve Yetiştiricilik, Kahramanmaraş Sütçü İmam Üniversitesi, Ziraat Fakültesi yayınları, Kahramanmaraş, s242-243.

Halkman, A.K. (2005).Gıda Mikrobiyolojisi Uygulamaları, Merck, Ankara.

Hutkins, R., (2006). Microbiology and Technology of Fermented Foods. Blackwell Publishing, Garsington Road, Oxford.

İç, Ö., Özçelik, F & Denli, Y. (1998) Hıyar Turşusu Üretiminde pH Stabilitesinin Fermentasyon Üzerine Etkisi. Ankara Üniversitesi Ziraat Fakültesi Gıda Mühendisliği Bölümü, Ankara, 23 (2): 87-95.

Ji, X., Wu, Y., Wu,X., Lin, Y., Xu,W., Ruan, H & He, G. (2013). Effects of LacticAcid Bacteria Inoculated Fermentation on Pickled Cucumbers. Zhejiang University, Fuli Institute of Food Science, P.R.China, 1610-1617.

John, R. P., Nampoothiri, K. M. & Pandey, A. (2007). Fermentative production of lactic acid from biomass: an overview on process developments and future perspectives. *Applied Microbiol Biotechnology*. 74: 524- 534.

Li, K.Y. (2004). Fermentation: Principles and Microorganisms. In: Handbookof Food and Beverage Fermentation Technology. Marcel Dekker Inc, Madison Avenue, Newyork. p. 595-610.

Nout, R. (2001). Fermented Foods and Their Production. In: Fermentation and Food Safety, Eds M.R. Adams and M.J.R. Nout. Aspen Publishers, Inc. Gaithersburg, Marylarnd. p.1-19.

Ova, G. (2002). Hıyar Tursularında Duyusal Kalite Karakteristiklerin İncelenmesi. *Gıda*, 27 (4): 315-319.

Özçelik, F., İç, E &Yıldız, Ş. (1998). Effect of pH Stability on Cucumber Fermentation. *Gıda* 1998, 23(2) : 87-95s.

Özçelik, F., İç, E & Denli, Y. (1999). Effects of Calcium Acetat and Pasteurization on Cucumber Pickle Storage. *Gıda* (199) 24 (4):243-250s.

Özçelik, F & İç, E. (1999). A Study on The Fermentation of Cucumber in Low- Salt Brine. *Gıda* (1999) 24 (2):77-87s.

Özçelik, F & İç, E (2000) Hıyar Turşularının Düşük Tuz Konsantrasyonlarında Depolanması Üzerine Bazı Koşulların Etkileri. *Tarım Bilimleri Dergisi 2000*, 5(4), 155-119s.

Özçelik, F & Ulu, T. (2002). Depolanmış Hıyar Turşularının Kimyasal Ve Mikrobiyolojik Özellikleri Üzerine pH' nın Etkisi. Ankara Üniversitesi, Ziraat Fakültesi, Gıda Mühendisliği Bölümü, Ankara. *GIDA* 27 (3): 169-176.

Robinson, R. W & Decker-Walters, D.S. (1997). Cucurbits. CAB Int. University Pres, Cambridge. 226 s.

Ross, R.P., Morgan, S & Hill, C. (2002) Preservation and Fermentation: Past, Present and Future, International Journalof Food Microbiology, 79: 3-16.

Sakar, K.M & Tanker, M. (1991) Fitokimyasal Analizler. Ankara Üniversitesi Eczacılık Fakültesi Yayınları, No:67: s22-26.

Shinagawa, H., Nishiyama, R., Miyao, S & Kozaki, M. (1996). Organic Acid Composition and Quality of Japanese 'Shibazuke' Pickles. Ayowa Women's University, Japon. 170-172.

Tokatlı, M., Elmacı, S. B., İşleyen, N. A., & Özçelik, F. (2019). Seçilmiş endojen laktik starter kültür ile turşu üretimi. Gıda, 44(4), 742-757.

Uylaşer, V & Erdem, F. (2004). Stoklanmış Hıyarlardan Farklı Uygulamalarla Turşu Üretimi. *Uludağ Üniversitesi Ziraat Fakültesi Dergisi*, 18(1):81-92s.

Yıldız, N. & Bircan, H. (2003). Araştırma ve Deneme Metotları, Atatürk Üniv. Ziraat Fak. Yayınları. Yayın No:305, Erzurum, 266 s.