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QUALITY OF TABLE OLIVES IN RELATION TO PICKLING PROCESS AND FERMENTATION TIME.

ElSorady, M.E.I.
Oils and Fats Dept, Food Tech. Res. Inst., Agric. Res. Center, Giza, Egypt.

ABSTRACT

Table olive is one of the important appetizers in the Mediterranean region. Quality of table olive rely on the cultivar and pickling process especially fermentation process. Therefore, the aim of this work was to evaluate the effect of pickling and fermentation process on quality of table olive such as, chemical characteristics and sensorial properties. Olives treated with NaOH 2%(w/v) for 5-6.5 (h) then washed with water for 24-32 h (3-4times/8 h) for that treated olives and covered with gradient brine solution of 6% for the first 24 h, 8% for the next 24 h and 10% for the third 24 h and finally the brine concentration was reduced to 8% (w/v) during the fourth day and left for 12 months at room temperature to undergo the characteristic lactic fermentation process. Sensorial properties evaluated at 3, 6, 9 and 12 months of fermentation and chemical characteristics determined with an interval of one month during the storage time of 12 months.

The obtained results revealed that titratable acidity and Nacl content increased with increasing the fermentation time which continued for 12 months. The pH value decreased during the fermentation period .Sensory analysis of table olives by International Olive Council method showed that hardness, fibrousness, crunchiness and bitter decreased during the fermentation period. On the other hand, salt and acid increased during the fermentation period. Baladi cultivar showed the best physicochemical and sensory quality during fermentation for 12 months followed by Agazi cultivar as compared to the other cultivars (Akhs, Azizi and Tofahi).

Keywords: Quality- Sensory analysis -Table Olives -Baladi - Agazi -Akhs -Azizi - Tofahi cultivars

INTRODUCTION

Olives (*Olea europaea* L.) are commercially grown throughout the world in areas of Mediterranean climate. Cultivation is primarily for oil and table olive products (Burns *et al*., 2008).Table olives, a manufactured food, must be produced using appropriate, environmentally acceptable technologies under safe conditions for consumers and workers. The olives need to be grown, harvested, stored and transported by methods that minimize physical damage; chemical and microbiological contaminations (Garrido Fernandez *et al.*, 1997).The world production of table olives is 2088 thousand tons (2009/2010), with approximately 85 % coming from countries of the Mediterranean area. According to the recent International olive council (IOC) report (IOC, 2010), the European Community (EC), Turkey and Egypt accounted for over 65% of the world table olive production over that time. Egypt produced 300000 tons (14 %) of the world table olive production over that time. Over the last 10 crop years world consumption of table olives has risen by 6%. Egypt consumption is 11% of world consumption of table olives after EU 28% and Turkey 16% (IOC, 2010).People living in EC countries in

the around the Mediterranean basin, in the Middle Eastern countries and the USA consumed most of these olives. Reasons given by the IOC for increased world table olive consumption include: extra availability, better presentation, enhanced quality, population increases and the increased purchasing power of consumers. There is a delicate balance between table olive production and consumption. Any shortfall in world table olive consumption and production is generally met from olives carried over from the previous season. Egypt is one of major producing and consuming countries of table olives. (Kailis and Harris, 2007).Table olives can be used as flavoring, an ingredient or simply as a snack or appetizer. They are especially used in Mediterranean dishes including pizza, relishes, salads, sauces or antipasto platters (Öngen *et al*., 2005).Regardless of the type of finished olive product, whether Spanish-style green, Greek-style black or Californian-style black, a lye and/or salt fermentation process is used to debitter and preserve the olives. The use of salt, vinegar, pH adjustment, preservatives, pasteurization or sterilization ensures products are free of organisms harmful to health or that can cause deterioration of the sensory characteristics of the product (Garrido Fernandez *et al.*, 1997).

Therefore the aim of this work was to evaluate the effect of pickling process and fermentation time on the quality of table olive.

MATERIALS AND METHODS

Materials:

Green olive fruits (*Olea europaea*) namely: Agazi, Baladi, Akhs, Azizi and Tofahi cultivars (5 kg each) were purchased from the local market, Egypt. **Salt:** (Sodium chloride, food grade) (10 kg) was purchased from El-Nasr Salt Company, Alexandria, Egypt. All chemicals used (analytical grades) were purchased from El-Nasr Pharmaceutical Chemical Company, Alexandria, Egypt.

Methods:

Olives with a green-yellow surface color were purchased at the local market during (2008/2009) season and graded to eliminate leaves and small fruits.

As is customary in the industrial procedure, olives were stored for 24 h (21 ± 2°C) before processing to avoid sloughing of fruits when treated with NaOH.

Olive fruit cultivars (5 kg each) were separately placed in cylindrical glass vessels and covered with 4 L of 2.0% (w/v) NaOH solution. The alkaline treatments lasted 5-6.5 h at room temperature until the lye penetrated two-thirds of the distance to the pit, tested with ph.ph. solution every one half hour according to Garrido Fernandez, *et al*. (1997). The NaOH solution was then poured off, and the olives were washed in running water for 24-32 h (3-4times/8 h) for that treated with 2.0% NaOH. After washing steps, olives were covered with gradient brine solution of 6% for the first 24 h, 8% for the next 24 h and 10% for the third 24 h and finally the brine concentration was

reduced to 8% (w/v) during the fourth day (Garrido Fernandez, *et al*., 1997). The final products were size graded and packed in small hermetically sealed glass containers (400 g each) with anew brine (8% w/v) and left for 12 months at room temperature to undergo the characteristic lactic fermentation process (Garrido Fernandez, *et al*., 1997). Samples of pickled olive fruits were taken during storage with an interval of one month up to 12 months for physicochemical and sensory analysis.

Proximate analysis of fresh olive fruits:

1. Weight of fruit:

Fresh olive fruits (100 fruits) from each cultivar were weighed and weight of a fruit was calculated (g) (Garrido Fernandez, *et al.,* 1997).

2. Size of fruits (fruit/kg)

Fresh olive fruits (1 kg) from each cultivar were weighed and number of fruits was counted as fruits/ kg weight and as fruit/pound (1 kg =2.20459 pound) (Garrido Fernandez, *et al.,* 1997).

3. Size grades

Size grades for fresh olives were determined according to Balatsouras *et al*. (1996).

Size grade	Average number of olives per pound
Small	135
Medium	113
Large	98
Ex. Large	82
Mammoth	70
Giant	53-60
Jumbo	46-50
Colossal	36-40
Super-Colossal	Maximum 32

4. The maturity index (MI)

The maturity index (MI) for each cultivar was determined according to Hermoso *et al.* (1991) and varied between 0 and 7. Olive fruits, 100 for each sample, were randomly taken, classified into the categories below, and homogenized prior to storage. The categories were: 0-olive with intense green or dark green epidermis; 1-olive with yellow or yellowish green epidermis; 2-olive with yellowish epidermis but with reddish spots or areas over less than half of the fruit; 3-olives with reddish or light violet epidermis over more than half of the fruit; 4-olives with black epidermis and totally white pulp; 5-olives with black epidermis and less than 50% purple pulp; 6-olives with black epidermis and violet (more than 50%) or purple pulp; 7-olives with black epidermis and totally dark pulp. With *a* to *h* being the number of fruits in each category, the MI is:

MI = (*a* x 0 + *b* x 1 + *c* x 2 + *d* x 3 + *e* x 4 + *f* x 5 + *g* x 6 + *h* x 7)/ 100.

5. Moisture content:

Moisture content of the fresh olive fruits was determined according to AOAC, (1990). An appropriate weight (10 g) of the olive fruits was dried in an oven at 105°C until a constant weight was reached.

6. Reducing sugars:

Reducing sugars of fresh fruits were determined according to (Fernandez Diez *et al.,* 1985).

7. Lipid content:

Lipid content of flesh of fresh fruits was extracted using the chloroform/methanol (2:1) according to Folch method (AOCS, 1989).

8. Crude protein:

The total nitrogen was determined using Kjeldahl method according to (AOAC, 1990). The crude protein was calculated by multiplying the total nitrogen by a factor of 6.25.

Chemical analysis of pickled olive fruits:

Both of fresh and pickled olive fruits were prepared for analysis of titratable acidity, pH, and sodium chloride content. These parameters are Critical Control Points (CCP) of fermentation plus texture and appearance of olive (IOC 2005). Each determination was carried out in triplicate and the average of three determinations was recorded.

1. Titratable acidity:

This represents the sum of the different free organic acids which are present in the juice according to Fernandez Diez *et al.* (1985).

2. pH:

Olive flesh was grinded in blender (Moulinex M.R., France), then pH was determined in the homogenized juice obtained with a pH meter (pH-Meter CG710 SCHOTT GERATE GMBH- D6238 HOFHEIM- Germany).

INTENSITY →

PERCEPTION OF NEGATIVE SENSATIONS

Abnormal fermentation (type) _____
Other defects (specify) _____

PERCEPTION OF GUSTATORY SENSATIONS

Salty _____
Bitter _____
Acid _____

PERCEPTION OF KINAESTHETIC SENSATIONS

Hardness _____
Fibrousness _____
Crunchiness _____

Sample code:
Name of taster:
Date:

Figure 1: Table olive profile sheet

3. Sodium chloride content:

Sodium chloride determinations were made by the Volhard titration method (Garrido Fernandez, *et al*., 1997), using a standardized solution of silver nitrate and potassium chromate as indicator. The juice of the flesh was diluted with distilled water before titration (Fernandez.Diez *et al*., 1985).

4. Sensory analysis of pickled olives:

International Olive Council (IOC) established a new method for sensory analysis of table olives (new sheet for sensory) Fig (1) (IOC 2008).

RESULTS AND DISCUSSION

Proximate analysis of fresh olive fruits.

Data in table (1) shows physicochemical characteristics of the five green olive cultivars namely: Agazi, Baladi, Akhs, Azizi and Tofahi. Data revealed that the five cultivars had different physicochemical characteristics. Tofahi cultivar showed the highest fruit weight (13.1 g), whereas, Azizi cultivar showed the least (6.2 g). Both Agazi, Baladi and Akhs cultivars showed 8.7, 6.9 and 7.1 g, respectively).Fruit size (fruit/kg); is another important characteristic in table olives, it was determined to be 72,150,107,140 and 128 /kg for Tofahi, Azizi, Agazi, Baladi and Akhs cultivars, respectively. Size grade of table olives is super-colossal for Tofahi cultivar, Jumbo for Agazi cultivar, Giant for both Baladi and Akhs cultivars and finally mammoth for Azizi cultivar. Results revealed that maturity index for Baladi and Tofahi has 1.33 and 1.04, respectively and followed by Agazi, Akhs and Azizi cultivars (0.83, 0.71 and 0.63, respectively).

The main constituents of the flesh are water, lipid (oil), and sugars. Data of Table (1) showed the moisture content in fresh flesh of olive fruits. The revealed moisture content was ranged from 70.1 to 73.3% in fresh flesh olive fruits among the cultivars studied. These results are in agreements with the results obtained by Balatsouras *et al.* (1996). Moisture content plays an important role in table olive processing because all processing methods used require a series of exchanges between substances in the flesh and the surrounding solutions (NaOH solutions, brine, etc.)[Garrido Fernandez *et al.*, 1997].

Soluble reducing and non-reducing sugars are the most important components with respect to the fermentation and preservation stages in all types of table olive processing. In general, reducing sugars are the most important of the olive flesh sugars (90-95%), with slight differences due to maturation degree (Garrido Fernandez *et al*., 1997). Data in table (1) showed that soluble reducing sugars were varied among the five olive cultivars. Tofahi and Baladi cultivars showed the highest content (5.85, 5.82%, respectively). Agazi and Akhs cultivar gave 5.71, 5.1%, respectively. However, Azizi cultivar showed 4.95%. Data also revealed an inverse relationship between sugar content and oil content (i.e. Azizi cultivar showed the highest oil content among the five olive cultivars, and the lowest soluble reducing sugars).In contrast, Tofahi cultivar showed the lowest oil content

and the highest soluble reducing sugars. The inverse relationship between sugars and oil gave rise to a hypothesis on their biochemical relationship. Sugars decrease in a continuous manner when oil is accumulated in the fruit (Sanchez Gomez and Fernandez Diez, 1991).Data also in table (1) revealed an inverse relationship between oil content and moisture content. Azizi cultivar showed the highest oil content (22.14%). Baladi, Agazi and Akhs cultivars gave 18.94, 19.38 and 21.81%, respectively. Tofahi cultivar, however, showed the lowest oil content (17.9%). Data also revealed that the five cultivars had crude protein contents which varied from 2.45% for Baladi to 2.95% for the Tofahi cultivar.

Table (1). Physicochemical characteristics of fresh olive fruit cultivars.

Characters	Baladi	Agazi	Akhs	Azizi	Tofahi
- Wt of fruit (g)	6.9	8.7	7.1	6.2	13.1
- Size (fruit/kg) (fruit/pound)	140 63	107 48	128 58	150 68	72 32
- Specification (size grades)	**Giant**	**Jumbo**	**Giant**	**Mammoth**	**Super-Colossal**
-Maturity Index (MI)	1.33	0.83	0.71	0.63	1.04
- Moisture (%)	72.7	72.2	70.3	70.1	73.3
- Reducing sugars soluble (%)	5.82	5.71	5.1	4.95	5.85
- Lipids (%)	18.94	19.38	21.81	22.14	17.9
- Crude protein (%) (N x 6.25)	2.45	2.71	2.79	2.81	2.95

Results revealed approximately linear function of maturity index for all cultivars. The more maturity index, the lower the time (hours) required to penetrate NaOH (2%w/v) into the flesh. Baladi and Tofahi cultivars needed the lowest time required 5hr, while Azizi showed the longest time 6.5 hr. Agazi and Akhs cultivars showed 5.5, 6 hr, respectively. During lye treatment more organic acids are formed. These acids form salts in alkaline medium and the final result is an increase in the combined acidity. Acid formation has an important role in the later fermentation process since it permits an initial pH decrease to values appropriate for the growth of lactic acid bacteria (Garrido Fernandez *et al*., 1997). After alkali treatment, fruits were washed with water to eliminate the major portion of the lye remaining in the fruits. The duration and number of washings necessary are important factors to be considered (Borbolla y Alcala and Rejano Navarro, 1978). Data revealed that Baladi, Agazi and Tofahi cultivars showed 3 times/8 hrs. While Akhs and Azizi cultivars showed 4 times/ 8 hrs.

Chemical analysis of pickled olives:

Critical Control Points (CCP) during fermentation are pH value, sodium chloride concentration, lactic acid content, texture and appearance of olives according to IOC (2005).Pickled fruits were also investigated each one month during the fermentation process for 12 months. Analysis was carried out for titratable acidity, pH, salt content and sensory analysis.

1. Titratable acidity:

Figure (2) shows effect of fermentation time on the titratable acidity of the pickled olives. Results revealed that the titratable acidity increased with

increasing the fermentation time continued up to 12 months. The titratable acidity of pickled cultivars ranged from 1.2 to 1.56 g lactic acid/100 ml juice after 12 months of fermentation.

Similar results were reported by Sciancalapore, (1984) and Mondher and Chakib (1993).

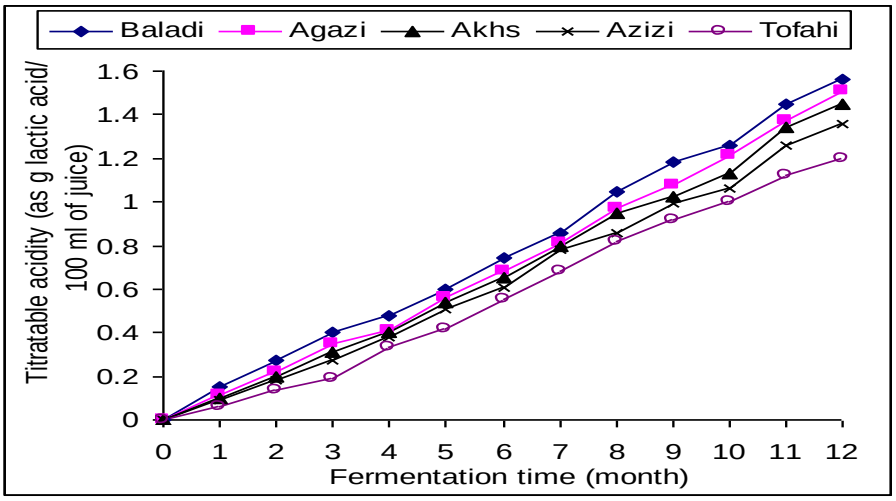

Figure (2): Effect of fermentation time (month) on the titratable acidity of pickled olives.

2. pH:

Figure (3) shows the effect of storage time (fermentation process) for 12 months on the pH values of the pickled olives. Results showed that the pH values of all cultivars were approximately the same with a very slight variation ranged from 8.01 to 8.29 in the start of fermentation process. Results also revealed that the pH values of all cultivars sharply declined from around pH of 8.0 to about 5.0 after a month of fermentation period. During the following eight months, the pH values were steadily declined and the values were around 4.0. Data revealed that the pH values were varied from 3.06 for Baladi cultivar to 4.24 for Tofahi cultivar after storage for 12 months. However, Agazi cultivar had 3.35 followed by Akhs and Azizi cultivar 3.7 and 3.97, respectively.

Baladi exhibited the lowest pH values followed by Agazi, Akhs, Azizi and Tofahi, respectively.

3. Nacl content:

Figure (4) shows the effect of fermentation time (12 months) on the Nacl contents of pickled olives. Data revealed that all cultivars contained no Nacl at the start of fermentation process. Results also revealed that the Nacl absorbed by the olive fruits increased with increasing the fermentation time .Nacl content was varied from 0.74 to.0.95%w/v after the first month of fermentation.

Data revealed that Baladi, Agazi, Akhs, Azizi and Tofahi cultivars showed descending order for Nacl content. Baladi showed the highest content while the Tofahi showed the lowest Nacl content.

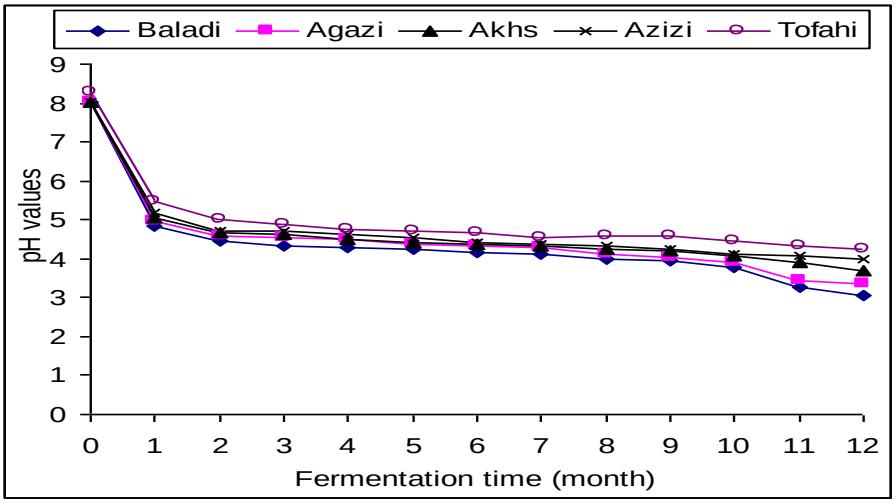

Figure (3): Effect of fermentation time (month) on the pH values of pickled olives.

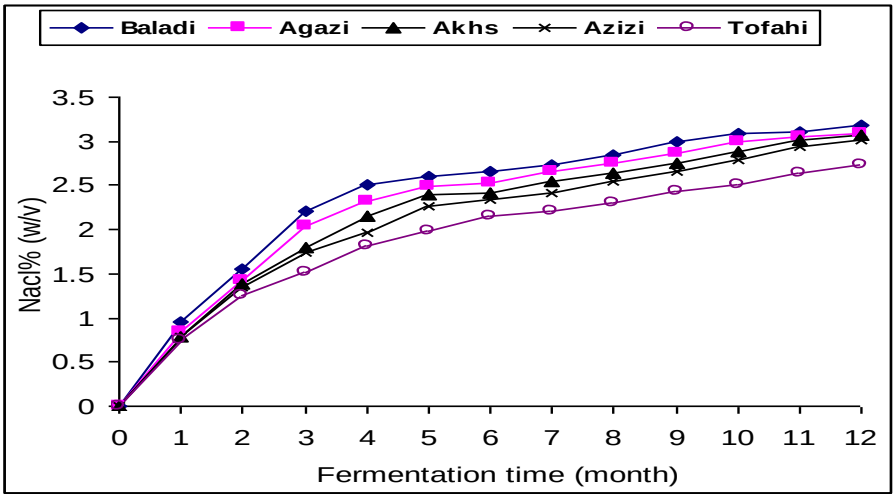

Figure (4): Effect of fermentation time (month) on the Nacl content (%) of pickled olives.

The presence of Nacl increased the ionic strength of the solution and thus helped also to achieve the necessary pH decrease (Garrido Fernandez *et al*., 1997).It is apparent that a high Nacl level leads to both low acidification rate and final titratable acidity. Balatsouras (1985) studied in detail the salt tolerance of many lactic acid bacteria isolated from Spanish-style and natural black fermentations, finding that the 6% Nacl inhibited growth of one-third of isolates from green olives. Above this salt level growth rate diminished dramatically and no growth at all was observed over 9%, which seems to be

the upper limit for the growth of lactic acid bacteria in the brine of Spanish-style green olives (Garrido Fernandez *et al*., 1997).

Sensory analysis of pickled fruits:

Sensory analyses of pickled fruits were investigated after 3, 6, 9 and 12 months of fermentation process. Results revealed that salty, acid attributes increased with increasing fermentation time. On the other hand, bitter, hardness, fibrousness and crunchiness attributes decreased with increasing fermentation time.

Comparing the sensory characteristics of the five cultivars, results (figures 5-9) revealed that Baladi cultivar showed the best sensory attributes followed by Agazi cultivar, Akhs, Azizi and finally Tofahi cultivar which showed the least sensory characteristics at fermentation time.

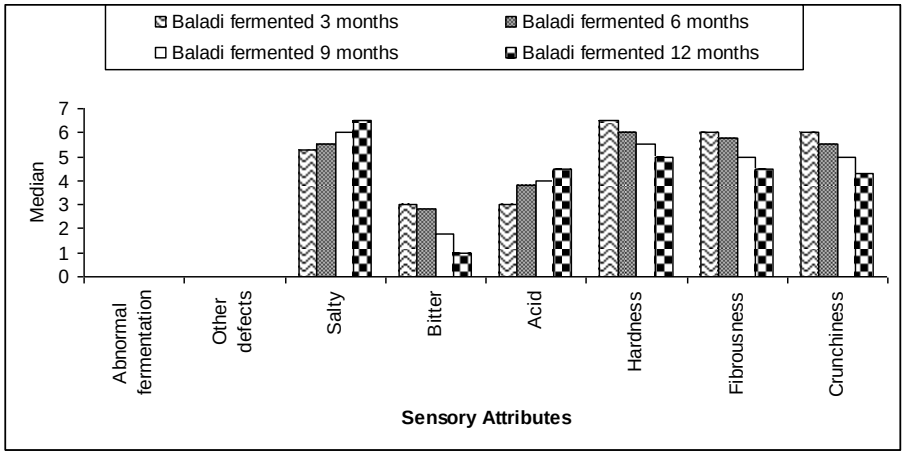

Figure (5): Effect of fermentation time on sensory attributes of Baladi pickled olives.

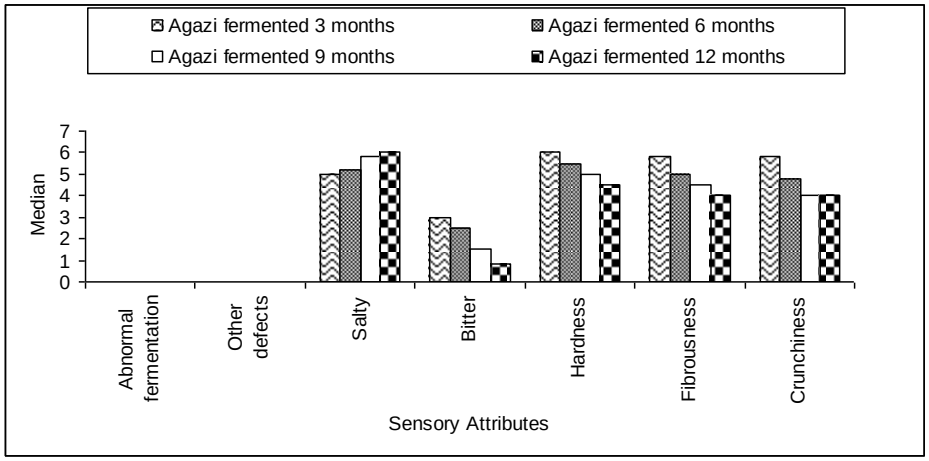

Figure (6): Effect of fermentation time on sensory attributes of Agazi pickled olives.

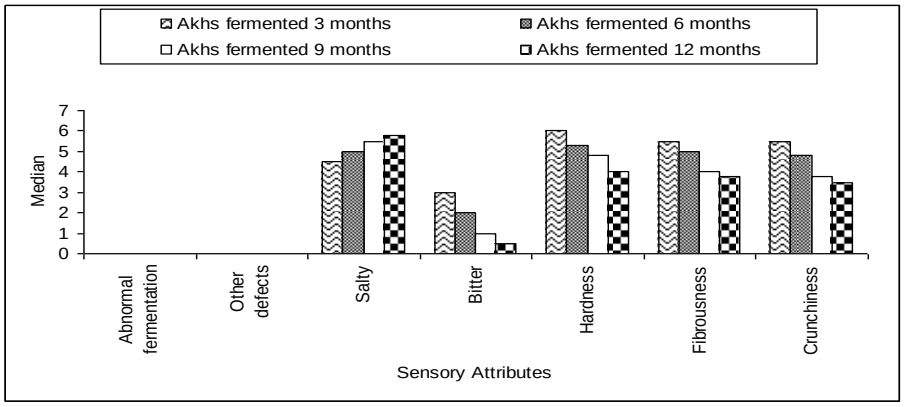

Figure (7): Effect of fermentation time on sensory attributes of Akhs pickled olives.

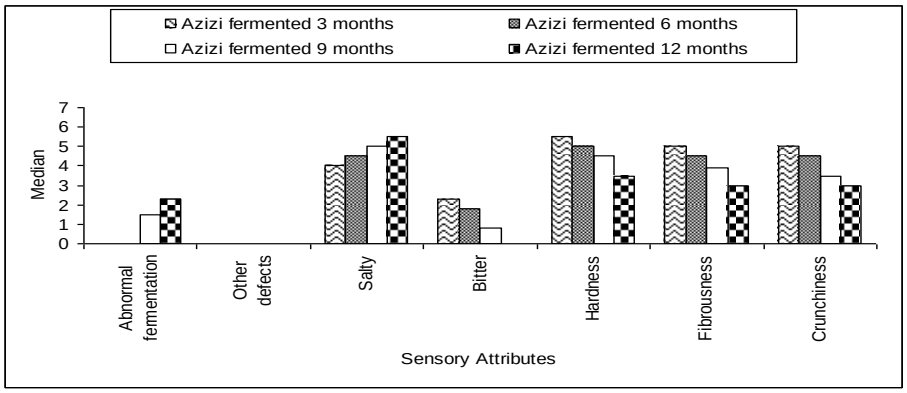

Figure (8): Effect of fermentation time on sensory attributes of Azizi pickled olives.

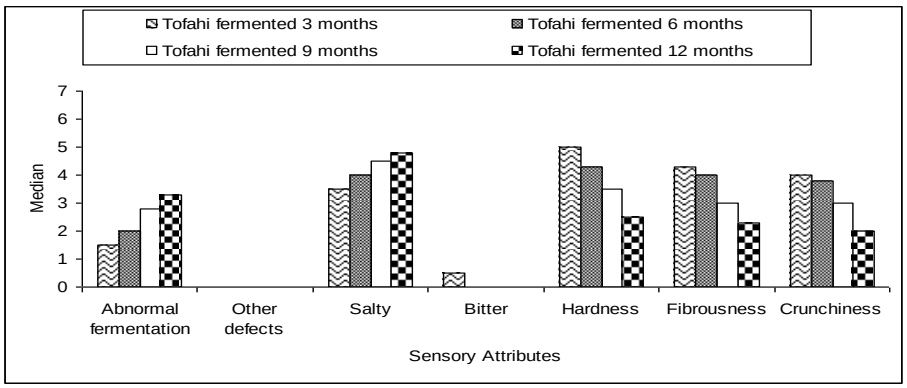

Figure (9): Effect of fermentation time on sensory attributes of Tofahi pickled olives.

Finally, to conclude, Baladi cultivar showed the best physicochemical and sensory quality during fermentation for 12 months followed by Agazi cultivar as compared to the other cultivars (Akhs, Azizi and Tofahi).

REFERENCES

A.O.A.C. (1990). Official Methods of Analysis. 15th ed., Association of Official Agricultural Chemists. Washington, DC.

AOCS, American Oil Chemists Society. (1989). Official methods and recommended practices. Am. Oil. Chem. Soc. Champaign.

Balatsouras G. (1985). Taxonomic and physiological characteristics of the facultative rod type lactic acid bacteria isolated from fermenting green and black olives. Grasas y Aceites, 36,239-49.

Balatsouras G.; G. Doutsias; A. Garrido Fernandez; and A. Brichigna (1996). Table olive processing technology pp307, 311. In World Olive Encyclopedia (1996), IOOC.

Borbolla y alcala, J.M.R. dela and Rejano Navrro, L.(1978). Sobre la preparation de las aceitunas estilo Sevillano. El Lavado de los frutos tratados con lejia. Grasas y Aceites, 29,281-91.

Burns J.K.; L. Ferguson; K. Glozer; W.H. Krueger; and R.C. Rosecrance (2008) Screening Fruit Loosening Agents for Black Ripe Processed Table Olives. HortScience 43(5):1449-1453.

Fernandez Diez, M.J.; R.de. Castro Ramos; A. Garrido Fernandez; F. Gonzalez Cancho; F. Gonzalez Pellisso; M. Nost. Vega; A. Heredia Moreno; M.I. Minguez Mosquera; L. Rejano Navrro; M.C. Duran Quintana; F. Sanchez Roldan; P. Gracia Gracia; and A. Castro Gomez Millan (1985). Biotechnologia de la aceituna de mesa, Consejo Superior de Investigacions Cientificas, Instituo de la grasa y sus derivados, Madrid, Sevilla, Spain.

Garrido Fernandez, A.; M.J. Fernandez Diez; and M.R. Adams (1997). Table olives: Production and Processing. Chapman Hall, London.

Hermoso, M.; M. Uceda; A. Garcia; B. Morales; M.L. Frias; and A. Fernandez (1991). Elaboracion de aceite de calidad. Consejeria de Agricultura y Pesca, Serie Apuntes, 5192., Sevilla.

IOC, International Olive Council (2008). Method Sensory Analysis of Table Olives, COI/OT/MO/Doc. No 1.

IOC, International olive Council (2005). Quality management guide for the table olive industry, T.OT/Doc. No. 14.

IOC, International olive council, (2010). Olive products market report summary no 35- January.

Kailis S, and D. Harris (2007). Producing Table Olives. 344pp. Land links Press, ©Stanley George Kailis.

Mondher, K. and B. Chakib (1993). Elaboracion de las aceitunas verdes aderezadas estilo Sevillano de la varidad "Meski". Olivae,48,54-7.

Öngen G.; S. Sargin; D. Tetik; and T. Köse (2005). Hot air drying of green table olives. Food Technol. Biotechnol. 43 (2) 181-187.

Sanchez Gomez, A.H. and M.J. Fernandez Diez (1991). Correlacion entre materia grasa, azucares reductores, y humedad enla pulpa de aceitunas. Grasas y Aceites, 42,414-19.

Sciancalapore, V. (1984). La temperatura di deamerizzazione nella preparazione delle olive verdi col sistema Sivigliano. Industrie Alimentari, 23,941-4.

جودة زيتون المائدة وعلاقتها بعمليات التخليل و فترة التخمر.

محمد السيد إسماعيل الصردى
معهد بحوث تكنولوجيا الأغذية- مركز البحوث الزراعية- الجيزة- مصر.

يعد زيتون المائدة من اهم المقبلات خاصه فى دول حوض البحر المتوسط فجودة زيتون المائدة تعتمد على الصنف و طريقه التخليل و بالاخص عمليه التخمر ولذلك كان هدف الدراسه هو التعرف على تأثير عمليه التخليل و التخمرعلى جودة زيتون المائدة من خلال الخصائص الكيماوية و الخواص الحسية اعتمادا علي احدث طرق التحليل الحسي ازيتون المائده التي وضعها المجلس الدولى للزيتون فقد اجريت هذه الدراسه على اصناف (البلدى- العجيزى- العقص- العزيزى- التفاحى) بمعامله الثمار بمحلول قلوى (هيدروكسيد صوديوم) ٢% ثم غسيل الثمار المعامله بالقلوى بالماء . ثم تمت عملية التمليح وذلك بوضع الثمار في محلول ملحي (كلوريد الصوديوم) تركيزه ٦% لمدة ٢٤ ساعة تم رفعها إلى ٨% لمدة ٢٤ ساعة التالية ثم رفعها إلى ١٠% لمدة ٢٤ ساعة التالية وفي النهاية تم تقليلها إلى ٨% وتترك للتخمر اللاكتيكي و تم تحليل الخصائص الكيماوية للثمار المخلله شهريا لمده ١٢ شهر و ثم التحليل الحسي بإستخدام الطريقه الجديدة التى وضعها المجلس الدولى للزيتون بعد ٣،٦،٩،١٢ شهر وربط هذا التحليل الحسى مع التركيب الكيماوى لزيتون المائدة اثناء عمليه التخمر

وكان من اهم النتائج التي تم الحصول عليها :

* نسبة الحموضة ومحتوى كلوريد الصوديوم للثمار زادت مع زيادة فترة التخمر المستمرة إلى ١٢ شهر.
* قيم pH قلت أثناء عملية التخمر (١٢ شهر).
* الثمار المخلله لصنف البلدى احسن الأصناف المخلله من حيث التحاليل الكيماويه و الحسيه و ان صنف التفاحى اقل الاصناف حسيا و كيماويا.

مما سبق نستنتج ان:

* صنف البلدى افضل الأصناف المستخدمه حسيا و كيماويا فى هذه الدراسه.
* صنف التفاحى اقل الاصناف حسيا لذا ينصح بعدم استخدام قلوى اثناء عمليه التخليل لهذا الصنف.

قام بتحكيم البحث

أ. د/ محمد طه شلبى	**كلية الزراعة – جامعة المنصورة**
أ. د/ محمد عبد الحميد زيتون	**كلية الزراعة – جامعة الأسكندرية**