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Effect of different rates of irrigation to olive trees on sensory attributes and Promological parameters of pickled olive fruits (Dolce var.)

Nahed M.M. Atta, Azza A.A. Ahmed, Enaam Sh.A. Mohamed and Mohamed Fawzy Al-Okaby

Fats and Oils Research Dep.; Food Tech. Research Institute, Agriculture Research Center, Giza, Egypt.

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ABSTRACT

This study was carried out in olive farm in Wadi El Natroun, El-Beheira Governorate, Egypt, to study the effect of deficit rate in different amount of irrigation water, 96, 64 and 32 liter water / tree per hr. (at rates 80, 53.4 and 26.6 %, respectively) are given to olive tree (Dolce var.) and 120 L. water/ tree per hr. (at rate 100%) as a control on the chemical composition and promological parameter (fruit characteristics) *i.e.* fruit weight, pulp weight, stone weight, pulp stone ratio, fruit length, width, fruit shaper ratio and 100-fruit weight of fresh and processed (pickled) olive fruits, and also on the organolyptic test of processed olive fruit and physic-chemical characteristics of brine throughout the process time (1, 2, 3 and 4 months) *i.e.* free acidity, combined acidity and pH. These results of this study revealed that, all parameters of fruit characteristics were decreased with decreasing amount of irrigation water, and they have decreased by pickling process. Processed olive fruits obtained from treatment 96 L. water/tree recorded the highest scores in odor, color, test and texture compared with processed olive obtained from other treatments. Higher content of oil in fresh fruits was found by reducing amount of irrigation water and by pickling process, and vice-versa for total protein. Total polyphenols and reducing sugar recorded higher increased by decreasing amount of irrigation water, but they have decreased after olive process.

Keywords: cv. Dolce, irrigation, deficit, quality and table olives

Introduction

Table olives are one of the most popular agro-fermented traditional food products in Mediterranean countries-mainly Spain, Greece, and Italy which together supply almost 30% of annual world olive production. Table olives are mainly composed of monounsaturated fatty acids and their consumption can prevent and reduce the risk of cardiovascular diseases. In addition, other minor constituents like tocopherols and phenolic compounds have antioxidant and antimicrobial properties (Lucrezia *et al.,* 2018). In the 2018/2019 crop year, the world table olive production was 2,751,500 tones and Egypt production was 450,000 tones (IOC, 2018). Recently, Egypt tops world production of table olives (Ministry of Agriculture, 2018).

Table olive differs from other fermented foods (carrots, cabbage, pumpkins and beans) in its chemical composition due to its relatively low sugar level (2-5%), high fat content 20-35% and its bitter taste caused oleuropein because of those characteristics, the olive- fruits are not edible without prior treatment (Faouzi *et al.,*2008).

Agronomic practices, in particular fertilization and irrigation, modify table olive quality, concerning irrigation, this partial increases fruit fresh weight volume, pulp/stone ratio, and mesocarp water content, but may also negatively affect fruit quality by decreasing the firmness and sugar concentration. The effect of irrigation on sugar concentration not clear yet. Although an increase of sugar was observed in Ascolana Tenera fruits from tree irrigated with 66% crop evapotranspiration (ETC). On the other hand, it seems that polyphenol concentration, bitterness, flavor, color and aromatic potential characteristics decrease during fruit ripening with water availability (Morales *et al.,* 2008).

Garica *et al.,* (1992) observed the changes in the main physico-chemical characteristics of brines and the evaluation of microbial population of lactobacillus planetarium. Also, Marco and Flora (2006) showed the changes in the physical and chemical characteristics of olive and brines throughout

Corresponding Author: Nahed M.M. Atta, Fats and Oils Research Dept., Food Tech. Research Institute, Agriculture Research Center, Giza, Egypt.

the process time, sodium chloride concentration as gradually increased Thus from 5% (w/v) to 6% after 60-75 days and 7% after 90 days.

Fruit size, pulp/stone ratio and 100-fruit weight are important quality parameters for the table olive industry fruit and they are important indicator organoleptic characteristics for table olives (IOC. 2014). Natural olives green olives, olives turning colour or black olives are placed directly in brine in which they undergo complete or partial fermentation, preserved or not by the addition of acidifying agents (Antonio *et al.,* 2006). Sometimes, acetic and lactic acids are added to the brine to promote a better fermentation by decreasing the pH below 4.5, especially in low-salt brines. Also, in some cases, calcium chloride ($CaCl_2$) is added to fermentation brines around 0.2% – 0.4% to give a crisp texture (Benkerroum 2013).

The use of suitable starter cultures (Lactic acid) is necessary to improve the microbiological control of the naturally black table olive process, help to standardize the fermentation, increase the lactic acid yield and according provide the production of olive with high quality. The requirements mentioned for starter cultures include a rapid and predominant growth, homofermentative metabolism, tolerance to salt, few growth factor requirements. Also, use of such starter cultures may be help to increase acidification to control some types of spoilage and to shorten the fermentation process (Kumral *et al.,* 2009).

The aim of this study was to evaluate the influence of deficit rate in amounts of irrigation water on the quality and sensory attributes of cv. Dolce table olives and determination of chemical analysis of brines through the process time.

Materials and Methods

Materials:- cv. Dolci olive fruits, lactic acid, calcium chloride and sodium chloride:-
lactic acid, calcium chloride and sodium chloride obtained from Al-Jomhoriah Company for Drugs, Chemicals & Medical Supplies.
cv. Dolci olive fruits were obtained from farm in Wadi El Natroun, El-Beheira Governorate, Egypt. After experimental carried out as follow:

Experimental olive farm:

The study was carried out in an experimental olive farm of Dolce var. (7 years old) olive trees planted at 6 × 6 m and grown in sandy soil at the experimental farm was in Wady-El-Natron, El-Behera governorate, Egypt. Drip irrigation system was applied using underground water its salinity 1600 ppm. The experiment followed complete randomized block design, with 3 blocks pretreatment and three trees per plot.

Four treatments: were applied before commencement of this assay: 120, 96, 64 and 32 liter water/tree (per hour). 120 liter water/tree (per hr.) was used as the control to compare the results obtained from it with the results of other irrigation treatments (96, 64 and 32 L.W/tree).

Fertilization:

Fertilization was used to supply mineral before irrigation treatments were put into action, ammonium nitrate (33%) with rat 2 Kg/tree were divided into equal doses from April to September, potassium sulphat with rat 1 Kg/tree/year divided into doses per 15 days, half Kg phosphor/ tree during winter fertilization on dose in trenches around the tree, it is added liter from sulphoric acid by exchanges with phosphoric acid once per month, the selected trees were sprayed three times/year with solution consist of boric acid plus urea (N) plus calcium nitrate (Ca) during flowering and fruits period.

Harvest olive fruits:

Olive fruit samples obtained from irrigation treatments trees were harvested throughout ripening (green) were gathered, the samples were collected by hand, then picked at each sampling and bring to the laboratory for pickling process.

Pickling and fermentation process:

Pickling process according to methods described by Erten and Tanguler, (2014**)** (without alkaline treatment) with some modification as follow: All olive fruits of treatment are placed into brine with salt concentration (6%), 0.1% lactic acid and 0.2% $CaCl_2$, and fermentation at ambient temperature for four months. During the process time, the brines of treatments were taken per month for determination of chemical analysis of brines.

Promological parameters (fruit characteristics) of olive fruits:

Samples of 20 fresh olive fruits from each replicate tree i.e. 60 fruits from each of the applied treatments were picked randomly at harvest and also, the same number from processed olive fruits were taken randomly to determine: Average fruit weight (g), width (cm), length (cm) and pulp/seed ratio fruit were described by Kaya *et al.* (2017).

Chemical composition of olive fruit:

Moisture, oil contents, crude protein, crud fiber and total carbohydrates of fresh and processed olive fruits were determined according to the methods of A.O.A.C (2000).

Reducing sugar:

Reducing sugar of fresh and processed olive fruits was determined according to the Luff-Scroll method (Uylaser and Basoglu, 2000).

Total polyphenols:

Concentration of total polyphenols of fresh and processed olive fruits was determined in 10 g sample of fresh and pickled milled pulp by extraction with a 75: 25 water: ethanol mixture. The folin-Ciocalteu reagent was added and colorimetric measurement at 725 nm was made with a shemadzu spectrophotometer ultraviolet-vis (Model Lambed, 120-02) (Vazquez *et al.,* 1971).

Chemical analysis of brine:

Titratable acidity (as lactic acid), pH value and combined acidity of brines of all treatments during the process time were determined according to the method described by Kumral *et al*. (2009).

Sensory properties:

Sensory properties were evaluated as described by Balatsouras and Doutsias (1983), where the final products from all treatments of pickled fruits (after four months from olive processing) were present to 10 trained member panelists for organoleptic evaluation. The panelists were requested to assess the samples for taste, color, texture and over all acceptability by 10 points in scale levels of quality.

Result and Discussion

Chemical composition of fresh and processed olive fruits (Dolce var.):

Table (1) showed an important effect of received different amount of irrigation water (120, 96,64 and 32 L w/tree) for olive trees (Dolce var.) on the chemical composition (moisture, oil, protein, total carbohydrates, crude fiber, reducing sugar and polyphenol contents) of fresh and processed olive fruits (after 4 months). From the data in table (1) it could be noticed that, there was a lower content of moisture as a results lack of amount of irrigation water, but it was recorded a slight increased after pickling process.

Higher content of oil was found with reducing amount irrigation water and recorded a slight increase as a result pickling process. On the contrary, there were lower contents in protein and fiber with decreasing amount water, and also they have recorded decrease after pickling process.

The increase in oil content of processed olive by pickling process related to decrease in total carbohydrates and protein content (relative increase).But the decrement in protein content of pickled olive fruits compared with fresh olive may be related to soluble it in the brine during fermentation process.

The amount of total carbohydrates and reducing sugar were increased by decreasing amount of irrigation water, but they have decreased after pickling process. The decrease in total carbohydrate and reducing sugar in processed olive fruit may be due to lactic acid bacteria which convert the carbohydrates especially soluble carbohydrates by enzymes which produce it to lactic and acetic acids, ethyl alcohol and carbon hydroxide during fermentation process (Madigan *et al.* 2012).

Total polyphenols of olive fruits recorded a higher increased by decreasing amount water, but it was decreased after pickling process. This decrease in polyphenols of processed fruits related to migration it from olive fruits to the brine during fermentation process (Giorgia Perpetuini *et al.,* 2018).

Table 1: Effect of different amounts of irrigation water on the chemical composition of olive fruits (dry weight).

Chemical Composition (%)	Olive fruits obtained from irrigation treatments (L.w/T)							
	Fresh (control)				Processed			
	120	96	64	32	120	96	64	32
Moisture	63.40	63.12	62.48	57.84	69.63	64.11	63.51	66.26
Oil contents	35.31	37.20	38.80	39.39	35.72	37.56	38.96	39.64
Total protein	9.54	7.38	7.05	6.65	7.63	6.26	5.84	5.45
Crude fiber	24.95	21.33	19.38	15.17	24.62	20.85	19.02	15.0
Total carbohydrates	17.80	21.41	22.17	24.12	16.75	20.92	21.51	22.40
Reducing sugar	6.17	6.45	7.60	8.88	6.04	6.13	7.03	7.22
Polyphenols content(ppm)	209.61	307.87	420.03	455.26	160.50	243.71	325.49	372.40

Promological parameters of olive fruits:

Promological parameters (fruit characteristics) of fresh and processed olive fruits tabulated in Table (2), data in this table show the effect of difference in amounts of irrigation water to olive trees (120, 96, 64 and 32 liter water/tree) on the characteristics of fresh and pickled olive fruits (fruit, weight, pulp weight, stone weight, pulp stone ratio, fruit length, fruit width, fruit shaper ratio and 100-fruit weight). Generally, the quality of pulp is very important to evaluate if such fruit can be processed, also the ratio of pulp to stone is very important to evaluate mass distribution between the pulp and the stone. And also, fruit size, pulp/stone ratio and 100 fruit weight are important quality parameters for the table olive industry. Regarding with data in the same table, the values of the previous parameter showed variation according to the levels of amounts irrigation water applied and also as a result fermentation process for olive fruits, all parameter decreased with decreasing amount water, and also decreased it with pickled process compared with control samples (fresh olive). The decrease in fruit weight, pulp weight, pulp/stone ratio and 100 fruit weight may be due to the decrement in sold contents of olive fruits (total carbohydrate, protein and crud fiber by pickling process under investigation).

Table 2: Effect of different amounts of irrigation water on the Promological parameters of olive fruits.

Promological parameter	Olive fruits obtained from irrigation treatments (L.w/T)							
	Fresh				processed			
	120	96	64	32	120	96	64	32
Fruit weight (g)	4.62	4.42	4.17	3.46	4.22	3.95	3.75	3.25
Pulp weight (g)	3.75	3.58	3.35	2.72	3.36	3.11	2.95	2.51
Stone weight (g)	0.87	0.84	0.82	0.74	0.86	0.84	0.80	0.74
Pulp/stone	4.31	4.26	4.09	3.67	3.95	3.70	3.68	3.39
Fruit length (cm)	3.16	3.03	2.90	2.08	2.95	2.70	2.62	2.07
Width (cm)	1.45	1.40	1.35	1.10	1.41	1.39	1.35	1.12
Fruit shaper ratio	2.18	2.16	2.14	1.89	2.90	1.94	1.94	1.84
100-fruit weight (g)	440.60	428.66	395.66	392.50	425.55	412.90	373.40	368.95

Changes in pH, free and combined acidity of brine during pickling process:

Changes in the pH, free and combined acidity of brines as a result of irrigation treatments (120, 96, 64 and 32 L.w/tree) throughout the process time (1, 2, 3 and 4 months) illustrated in Table (3), from the data in this table it could be observed that, the free and combined acidity of brines for all treated samples recorded gradually increased with reducing amount of irrigation water.

Also, values of free and combined acidity of brines for all irrigation treatments throughout the process times (1, 2, 3 and 4 months) were increased compared with the values of brines before pickling process (blank sample). These results agreement with (Harris 1998). The increment of free and combined acidity related to the free acidity released from processed olive fruits to the brine and the organic acids produced by bacteria (Behera *et al.,* 2018 and Benítez-Cabello *et al.,* 2019). Also, the data in the same table revealed that, there was a slight change in pH values of brines as a results irrigation treatments and pickling process.

Table 3: Effect of different amounts of irrigation water on physic-chemicals properties of brine during the process time.

Irrigated Treatments (L.W/T)	Process time (month)	Physic-chemicals properties of brines: Free acidity (%)	Combined acidity (%)	pH
	Blank Sample (Zero time)	**0.198**	**0.0156**	**4.88**
120	1	0.315	0.027	4.62
	2	0.234	0.036	4.88
	3	0.200	0.056	4.93
	4	0.199	0.064	5.06
96	1	0.396	0.031	4.56
	2	0.267	0.044	4.84
	3	0.225	0.090	4.88
	4	0.200	0.076	5.00
64	1	0.414	0.036	4.47
	2	0.295	0.045	4.77
	3	0.288	0.117	4.82
	4	0.220	0.095	4.90
32	1	0.414	0.044	4.29
	2	0.329	0.048	4.60
	3	0.324	0.126	4.70
	4	0.311	0.140	4.82

Sensory analysis of pickled olives:

Results of the sensory analysis (odor, color, taste, texture and bitterness (Table 4) showed clear changes among processed green olive samples, as a result reducing in amounts of irrigation water to olive trees at levels 32, 64 and 96 liter water/tree compared to control sample (120 liter water/tree). Pickled olives obtained from treatment 96 Lw/T recorded the highest scores in order, color, taste and texture compared with pickled olives obtained from others treatments. On the other hand, processed olives obtained from trees treated with 120 Lw/T (control) were the lowest scores in texture and bitterness. Generally, texture and bitterness in processed olive were increased by reducing amounts of irrigation water. This increase in bitterness may be related to increase the total polyphenols of processed olive by reducing amount of irrigation water to olive trees under study.

Table 4: Scores for sensory attributes of processed olive:

Irrigation treatments(L.W/T)	Sensory attributes: Order	Color	Taste	Texture	Bitterness
120 (control)	6.88	6.37	6.21	6.62	5.13
96	8.12	7.31	7.25	6.66	5.94
64	7.06	7.14	6.25	6.75	6.25
32	7.63	7.18	6.04	7.0	6.3

Conclusion

Deficit irrigation water and pickling process caused an increase in oil contents. On the other hand, all Promological parameter were decreased as results decreased amounts of irrigation water, and also it were decreased after pickling process. Pickling process caused decrease in total polyphenols and reducing sugar of processed olive compared with fresh olive fruits in all irrigation treatments. Pickled olive fruits obtained from irrigation treatment 96L.water/Tree was the highest scores in all organoleptic characteristics compared with processed olive obtained from other treatments.

Recommendation

The results presented in this paper show that the treatment 96 L.water/Tree (at ratio of 80%) can be recommended to obtained the best quality of table olive fruits for olive tree (Dolce var.), application of this recommendation can achieve 20% saving in water and make a significant contribution to the conservation of limited water resources.

References

A.O.A.C., 2000. Official methods of analysis of the association of official analytical chemists. 17th Edn., association of official analytical chemists, Washington, DC., USA.

Antonio, H.S.G., G.G. Perdo, R.N. Luis, 2006. Trends in table olive production. Grasas Aceites, 57 (1) 86-94.

Balatsouras, G. and G. Doutsias, 1983. Effect of fermentation and control on the sensory properties of conservolea variety green olives. Environmental Microbiology, 68-74.

Behera, S.S., R.C. Ray, N. Zdolec, 2018. *Lactobacillus plantarum* with functional properties: An approach to increase safety and shelf-life of fermented foods. Biomed Res Int., doi: 10.1155/2018/9361614.

Benítez-Cabello, A., B. Calero-Delgado, F. Rodríguez-Gómez, A. Garrido-Fernández, R. Jiménez-Díaz, F.N. Arroyo-López, 2019. Biodiversity and multifunctional features of lactic acid bacteria isolated from table olive biofilms. Front. Microbiol., 10, 836.

Benkerroum, N., 2013. Traditional fermented foods of North African countries: Technology and food safety challenges with regard to microbiological risks. Compreh Rev Food Sci Food Saf 12: 54–89. doi: 10.1111/j.1541-4337.2012.00215.x.

Erten, H. and H. Tanguler, 2014.Plant-based fermented products. In: Aran N (ed.). Food Biotechnology. Ankara Turkey. Nobel Yayinevi. Pp. 244-274 (in Turkish).

Faouzi, S., H. Saoussem, A. Cristelle, S. Khald, B. Sadok, K. Habib, 2008. α-Tocopherol and fatty acid contents of some Tunisian table olives (*Oleaeuropea* L.): Changes in their composition during ripening and processing. Journal Food Chemistry, 108: 833-839.

GaricaGarica, P., M.C. Duran Quintana, M. Brenes Balbuena, A. Garrido Fernandez, 1992. Lactic Fermentationduring storage of "Alorena" cultivar untreated green table olives J. Appl Bacterio 73, 324-330.

Giorgia, P., G. Caruso, S. Urbani, M. Schirone, S. Esposto, A. Ciarrocchi, R. Prete, N. Garcia-Gonzalez, N. Battistelli, R. Gucci , M. Servili, R. Tofalo and A. Corsetti, 2018. Changes in Polyphenolic Concentrations of Table Olives (cv. Itrana) Produced Under Different Irrigation Regimes During Spontaneous or Inoculated Fermentation. Front Microbiol., 9: 1287doi: 10.3389/fmicb.2018.01287.

Harris, L.J., 1998. The microbiology of vegetable fermentations. In: Wood BJB (ed.). Microbiology of Fermented Foods. London, U.K.: Blackie Academic & Professional, pp. 45–72.

International Olive Council (IOC), 2014, COI/OT/UO No 1/Rev.1, 2011 (06.08.2014).

International Olive Council (IOC), 2018. Table olive production, November 2018.

Kaya, U., F. OzturkGungor, G. Camoglu, E. Akkuzu, S. Asik and O. Koseoglu, 2017. Effect of deficit irrigation regimes on yield and fruit quality of olive trees (cv. Memecik) on the Aegean Coast of Turkey. Irrig and Drain. 66:820-827.

Kumarl, A., F. Basogilu and I. Sahin, 2009. Effect of the use of different lactic starters on the microbiological and physico-chemical characteristics of naturally black table olives of Gemlik cultivar. Journal Food Processing and preservation, 33:651-664.

EISSN: 2706 -7947 ISSN: 2077- 4613 DOI: 10.36632/mejas/2019.9.4.28

Lucrezia, C., C. Doniela, D. A. Maria, S. Carmine, M. P. Veto, P. Antonella and C. Francesco, 2018. Use of started cultures for table olive fermentation as possibility to improve the quality of thermally stabilized olive-based paste. LWT-Food Science and Technology, 90: 381-388.

Madigan, M.T., J.M. Martinko, D.A. Stahl and D.P. Clark, 2012. Biology of Microorganisms, 13th edn. New York: Pearson Education Inc., 1155pp.

Marco, P., Flora V. Romeo, 2006. Changes in chemical and microbiological parameters of some varieties of Sicily olives during natural fermentation, Grasas Y Aceites, 57 (4): 402-408.

Ministry of Agriculture, 2018, November, 23. Egyptian Minister of Agriculture and Land Reclamation. Available at: http://www.egypt today.com. Last accessed: 23/11/2018.

Morals- Sillero, A., R. Jimenez, J. E. Fernandez, A. Troncoso, and L. Rejano, 2008. Effect of fertigation on the Manzanilla de Sevilla Table olive quality before and after Spanish-style green processing. Hort Scince 43 (1): 153-158.

Uylaser, V., and F. Basoglu, 2000. Food Analysis I-II Implementation Guide. Uludag University, Faculty of Agriculture No.9, Bursa, Turkey.

Vazquez, A., R. Maestro and E. Graciano, 1971. Determinacion de Iospolifenols totals en pulpa de aceitunas. Grasas y aceites, 23:371-376.