CHEMICAL AND NUTRITIONAL EVALUATION OF OLIVE LEAVES AND SELECTION THE OPTIMUM CONDITIONS FOR EXTRACTION THEIR PHENOLIC COMPOUNDS

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ABSTRACT

This work was carried out to evaluate some chemical and nutritional properties of olive leaves *Olea europaea* L. Cv. Kalamata, and investigate the optimum conditions for extraction their total phenolic compounds. Chemical composition and minerals content of whole and boiled leaves were determined. Amino acids profile of olive leaves was also estimated. Phenolic compounds were extracted from the leaves using different solvents and different extraction times. The obtained results revealed that slight variations were observed between the whole and boiled olive leaves regarding their contents of crude protein, ether extract and ash contents that amounted in whole leaves 10.6, 7.9 and 6.8%, while in boiled leaves were 10.7, 8.1 and 6.7%, respectively. Olive leaves are a rich source of crude fiber and minerals. Calcium was the predominant element of whole and boiled olive leaves followed by potassium. Olive leaves are a good source of iron which amounted 19.1 and 19.5 mg/100g for whole and boiled olive leaves, respectively. Olive leaves contain all essential amino acids (except methionine) in favorable amounts and the total percentage was 57.51g/100g protein and lysine was the major essential amino acid (17.12%) followed by leucine (8.82%). Computed protein efficiency ratio and computed biological value of olive leaves protein were higher than those of casein. 70% ethanol for 8 hrs and boiled water (90^{o}C) for 10 min gave the highest amount of total phenolic compounds (38.8 and 39.2 mg galic acid equivalent/g, respectively). There was no certain correlation between increasing of time and the amount of phenolic compounds recovered from olive leaves.

Keywords: Olive leaves, chemical composition, minerals content, amino acids and total phenolic compounds

INTRODUCTION

Olive tree (*Olea europaea*) is an evergreen tree that has been cultivated for more than 7000 years and is found throughout the world, particularly in Mediterranean countries **(Fares *et al.*, 2011)**. Olive (*Olea europaea* L.) is one of the most important crops in the Mediterranean countries. More than eight million ha of olive trees are cultivated worldwide among which the Mediterranean basin presents around 98% of them **(Peralbo-Molina and de Castro, 2013)**.

Olive leaves have been mixed with overripe olives before processing to produce oils with a more marked flavor and a higher resistance to oxidation **(Ranalli *et al.*, 2003)**. Olive leaves are one of the by-products of olive farming; they accumulate during the pruning of the olive trees (about 25 kg of by-products (twigs and leaves) per tree annually) and can be found in large amounts in olive oil industries after being separated from fruits before processing (about 10% of olives weight) **(Herrero *et al.*, 2011)**.

Anter *et al.* (2011) reported that the olive leaves extract is useful in the protection of cells against the oxidative damage caused by hydrogen peroxide without genotoxicity and they could also be used to improve human health**. Sabry (2014)** stated that olive leaves are safe, non-toxic and well-tolerated by the majority of the population. No adverse reactions or toxicity reports have been documented, and no drug interactions are yet known. Due to its ability to lower blood pressure, olive leaf increases the effects of drugs that lower blood pressure.

Historically, olive leaf has been used as a folk remedy for combating fevers and other diseases, such as malaria. Several reports have shown that olive leaf extract increased blood flow in the coronary arteries **(Zarzuelo, 1991)**. Olive leaves could be considered as an important raw-material that have the potential to be used as a natural antioxidant and as an ingredient for the stabilization of vegetable oil **(Keceli and Harp, 2014)**.

The chemical analysis of leaves indicated that it is poor in N, rich in crude fat and acid detergent fiber and low in tannins **(Delgado Pertınez 1994)**. Olive leaves have high content of phenolic compounds **(Japon - Lujan *et al*., 2006)**.

The total phenolic compounds content of the olive leaf extracts ranged from 16.52 to 24.93 mg gallic acid g^{-1} dry matter **(Abaza *et. al.*, 2011)**. Moreover, **Salah, *et al.* (2012)** determined the extraction yield and total polyphenols content of leaves in eight olive cultivars and found that extraction yield ranged from 33 to 46% and total phenolic compounds content ranged from 73 mg/g to 144 mg/g dry leaves. They also reported that aqueous ethanol (70%, v/v) was the best solvent of extraction, since it yielded a high polyphenols content.

The most commonly extraction system used has been the solid-liquid extraction by maceration of the olive leaves in a solvent. Common extraction solvents used for olive leaves are methanol, ethanol, acetone, ethyl acetate, and diethyl ether, as well as aqueous alcohol mixtures as the usual solvents for polyphenols extraction **(Talhaoui *et al.*, 2014)**.

The extraction method, solvent and variety had a significant effect on the amount of phenolic compounds from olive leaves. In terms of

solvents applied, ethanol was the most effective one, producing the highest extraction yield and phenolic concentration at 24 h (69.027 mg TAE/ g). There was no certain correlation between increasing of time and extraction yield **(Rafiee *et al.*, 2011)**.

The aim of this study was to know the chemical composition and menirals content of olive leaves, evaluate their nutritional protein value and select the optimum conditions for extraction their total phenolic compounds.

MATERIALS and METHODS

Olive (*Olea europaea* L. Cv. Kalamata) leaves were obtained from the farm of Fac. of Agric., Kafrelsheikh Univ., Egypt. All chemicals and solvents used in this study were purchased from El- Gomhorea Company for Chemicals and Drugs, Tanta, Egypt.

Sample Preparation

After collection, fresh olive leaves are washed with tap water to eliminate any traces of dust. The cleaned olive leaves were divided into two parts. The first part was used as whole olive leaves. The second part was boiled in water at 90^{o}C for 10 min and used as boiled olive leaves. The olive leaves either whole or boiled were dried in an electric air oven at a temperature of 50^{o}C for 24 hr, then ground into a fine powder to pass through 60 mesh screen sieve. The ground powder was hold in tight glass jars and kept at (4^{o}C) until used.

Proximate chemical composition

Moisture, crude protein (N x 6.25), ether extract, ash and crude fiber contents were carried out followed the methods described in the **A.O.A.C. (2005)**. All analyses were performed in triplicates and the average was expressed on dry weight basis**.** Total carbohydrates content was calculated by difference as reported by **Tadrus (1989).** Available carbohydrates were calculated by subtracting crude fiber content from total carbohydrates.

Determination of minerals content:

Minerals were determined after wet ashing using 6N HCl. Magnesium; iron; manganese, zinc and copper were determined using the atomic absorption spectrophotometer (Zeiss FMD3). Sodium, calcium and potassium were determined by flame photometer. Phosphorus was estimated in the phosphorus molybdate complex by spectrophotometer at wavelength of 650nm, using a standard curve according to the methods described in the **A.O.A.C. (2005)**.

Nutritional evaluation of olive leaves protein

a) Identification and quantification of amino acids:

Amino acids composition of olive leaves was determined by amino acids analyzer (Beckman amino acid analyzer, Model 119CL) according to the method of **Duranti and Cerletti (1979)** in National Research Center, Cairo, Egypt.

b) Chemical score of amino acids:

Chemical score of essential amino acids was calculated using the **FAO/WHO (1991)** reference pattern; following the equation of **Pellet and Young (1980)** as follows:

$$\text{Chemical score} = \frac{\text{g Essential amino acid/100g protein in sample}}{\text{g Essential amino acids /100g protein in FAO/WHO}} \times 100$$

The amino acid that shows the lowest percent value of chemical score among the essential amino acids is called limited amino acid.

c- Computed protein efficiency ratio and biological value:

Computed protein efficiency ratio (C-PER) was estimated according to the regression equation proposed by **Alsmeyer *et al*. (1974).**

C-PER = -0.468 + 0.454 (Leucine) - 0.105 (Tyrosine).

Computed biological value (C-BV) of olive leaves protein was calculated as reported by **Farag *et al.* (1996**) using the following equation:

$$\textbf{\textit{C-BV = 49.9 + 10.53 C-PER}}$$

Where C-PER = computed protein efficiency ratio.

Determination of total phenolic compounds:

Total phenolic compounds were extracted according to the method of **Pereira *et al.* (2007)**. To determine the extraction yield of sample, 10 ml of the extract was evaporated under vacuum in rotary evaporator at 45° C and weighted.

The total phenolic compounds (TPC) were determined in the collected extracts according to **Thaiponga *et al*. (2006)**. The results were expressed as mg of gallic acid equivalents per g of dry sample (mg GAE/g).

Results and Discussions

Proximate chemical composition

The proximate chemical composition of whole and boiled olive leaves is presented in Table (1). From the data in this Table, it could be observed that whole olive leaves contain moisture content (50.5%) lower than that of the boiled ones (55.9%). Slight variations were observed between the whole and boiled olive leaves regarding their contents of crude protein, ether extract and ash contents that

amounted in whole leaves 10.6, 7.9 and 6.8% while in boiled leaves were 10.7, 8.1 and 6.7%, respectively. Crude fiber content in whole olive leaves was lower than that of boiled ones as shown in the same Table. It could be explain this result on basis that boiling process lead to release some constituents which are soluble in water such as polyphenols and pigments, constituently the other constituents especially that are insoluble in water such as most of fibers, concentrate in boiled leaves. The results also show that either whole or boiled olive leaves are to be rich source in protein, ash and carbohydrates. **Delgado Pertınez (1994)** found that olive leaves are rich in acid detergent fiber and low in tannins. **Cavalheiro *et al*. (2015)** determined the chemical composition of olive leaves from five varieties cultivated in Brazil. They found that protein, lipids, ash and total carbohydrates contents in fresh leaves ranged from 10.5 to 13.1, 9.13 to 9.8, 4.37 to 6.0 and 8.74 to 32.63%, respectively.

Table (1): Proximate chemical composition of whole and boiled olive leaves (on dry weight basis)

Components %	**Whole leaves**	**Boiled leaves**
Moisture	50.5	55.9
Dry matter	49.5	44.1
Crude protein (N x 6.25)	10.6	10.7
Ether extract	7.9	8.1
Ash	6.8	6.7
Crude fiber	14.5	16.6
Total carbohydrates	74·7	74·5
Available carbohydrates	60·2	57·9

Boudhrioua *et al.* (2009) analyzed the chemical composition of olive leaves from four varieties cultivated in Tunisia, and found protein and lipid values lower than those found in this study (ranging from 5.50 to 7.61%; and 1.05 to 1.30%, respectively). **Erbay and Icier (2009)** determined the composition of olive leaves from the Memecik variety, cultivated in Turkey, and found values smaller than those found in this study for protein (5.45%) and total lipids (6.54%).

It is clear that there are differences between the obtained results in this study and those published in the literatures. These differences may be attributed to the variation of varieties and origins. **Martín García *et al.* (2003)** determined the protein and lipid content of olive leaves in Spain and found 7.00% and 3.21%, respectively. They also stated that the chemical composition of olive leaves vary depending on origin, proportion of branches on the tree, storage conditions, climatic conditions and moisture content.

Minerals content of whole and boiled olive leaves:

Minerals composition of whole and boiled olive leaves are given in Table (2). The data clearly show that olive leaves are considered a rich source of minerals. The effect of boiling process on the minerals content appeared to be considerable, and the mean of mineral composition of whole and boiled olive leaves differed greatly. The results shown in the aforementioned Table reveal that calcium was the predominant element of whole and boiled olive leaves (1575.0 and 754.4 mg/100g, respectively), followed by potassium (656.0 and 652.2 g/100g, respectively). Phosphorus was found in lowest quantity of minerals (115.7 and 123 mg/100g for whole and boiled olive leaves, respectively) compared to other major elements.

Table (2): Minerals composition of whole and boiled olive leaves

Samples	Elements mg/100g dry sample								
	(Ca)	(P)	(Na)	(K)	(Mg)	(Fe)	(Cu)	(Mn)	(Zn)
Whole olive leaves	1575	115	140	656	193	19.1	0.9	4.3	2.5
Boiled olive leaves	754.4	123	156	652	194	19.5	1.2	6.3	3.2
(Rate of change)%	-52.1	6.3	12.0	-0.6	0.05	2.1	33.3	46.5	28.0

Interestingly, the values of all minerals (with exception calcium and potassium) of boiled olive leaves were higher than those of whole olive leaves. This result may be attributed to some compounds such as polyphenols and pigments soluble in water, consequently the water insoluble compounds such as minerals increased in the boiled leaves.

The obtained results also reveal that olive leaves contain considerable amounts of minerals, hence, when are added to bakery products such as bread and cake, would improve their minerals content. It could be also observed that the Ca:P ratio in olive leaves was 13.6 and 6.1 for whole and boiled leaves, respectively, this ratio should not be less than 1.0 in foods as recommended by **FAO / WHO (1991).** The same Table (2) also shows that either whole or boiled olive leaves are a good source of iron (19.1 and 19.5 mg/100g, respectively). The obtained results are in agreement with those of **Cavalheiro *et al.* (2015)** who mentioned that olive leaves could be considered not only a source of Fe and Cu, but also of Ca, Mg, K, P, Zn and Mn.

Nutritional evaluation of olive leaves protein

a- Amino acids composition

Data presented in Table (3) show the amino acid composition of whole olive leaves protein along with the provisional pattern recommended by the **FAO/ WHO (1991**). Amino acids in Table (3) are expressed as g amino acid /100g protein.

Table (3): Amino acids composition (g/100g protein) of olive leaves compared with whole egg protein

Amino acid	Olive leaves	Whole egg*	FAO/WHO (1991) pattern for adults
Essential Amino Acids (EAA)**			
Lysine	17.12	7.0	1.6
Valine	6.14	6.6	1.3
Leucine	8.82	8.6	1.9
Isoleucine	4.12	5.4	1.3
Phenylalanine	6.23		
Tyrosine	2.24		
Phenylalanine + Tyrosine	8.47	9.3	1.9
Cystine	8.15		
Methionine	0.00		
Cystine + Methionine	8.15	5.7	1.7
Therionine	2.32	4.7	0.9
Histidine	2.37	2.2	1.6
Total essential amino acids	57.51	49.5	12.2
Non-essential amino acids (NEAA)			
Aspartic	9.26		
Glutamic	9.54		
Serine	3.52		
Alanine	9.10		
Glycine	10.35		
Proline	0.31		
Arginine	0.41		
Total non-essential amino acids	42.49		
EAA : NEAA ratio	1.35		

*as reported by **FAO/WHO (1985)**, **Tryptophan is not determined.

Results in the aforementioned Table (3) indicated that olive leaves protein is rich in essential amino acids, and met human requirements for all the essential amino acids. It is important to mention that protein from whole olive leaves contains all essential amino acids (except methionine) in favorable amounts and the total percentage 57.51g/100g protein. This value is higher than that of whole egg (49.5g/100g protein) as a standard protein, which reported by **FAO/ WHO (1985)**, and it is much higher than that of pattern recommended by **FAO/ WHO (1991)** for adults (12.2g essential amino acid/100g protein).The results indicated also that lysine is the major essential

amino acid which amounted 17.12% followed by leucine (8.82%) followed by the aromatic amino acids (phenylalanine + tyrosine) which amounted 8.47% then cystine (8.15%). The concentrations of lysine, leucine, sulfuric amino acids and histidine in olive leaves protein are higher but the concentrations of remain essential amino acids (valine, isoleucine, aromatic amino acids and therionene) are lower than those of whole egg protein. The high content of lysine in olive leaves (17.12%) makes it important to supplement the cereals products which are poor in this amino acid.

From aforementioned the data recorded in Table (3), it could be also observed that all essential amino acids of olive leaves have values higher than those of pattern recommended by **FAO/WHO (1991)** for adults. The results also show that methionine was not detected in olive leaves, whereas tyrosine, therionine and histidine have the lowest concentrations of essential amino acids and valued 2.24, 2.32 and 2.37%, respectively. The leucine: isoleucine ratio of olive leaves (2.14:1) was higher than the ideal ratio (1.8:1) that was suggested by **FAO/ WHO (1991).** Data presented in the same Table clearly indicate that glycine (10.35%), glutamic acid (9.54%), aspartic acid (9.26%) and alanine (9.10%) were the most abundant nonessential amino acids, while arginine and proline were the lowest nonessential amino acids in olive leaves that amounted 0.41 and 0.31 %, respectively.

a- Chemical score of essential amino acids in olive leaves

The essential amino acid scores of proteins from olive leaves proteins, were calculated the data were recorded in Table (4). The data in this Table indicate that all essential amino acids of olive leaves protein are present in excessive chemical scores which ranged between 148 and 1070.

Table (4): Chemical score (CS) of olive leaves essential amino acids compared with whole egg as a reference

Amino acid	olive leaves (g/100g protein)	CS of olive leaves	whole egg (g/100g protein)*	CS of whole egg	FAO/WHO (1991) for adults
Lysine	17.12	1070	7.0	437.5	1.6
Valine	6.14	472	6.6	507.7	1.3
Leucine	8.82	464	8.6	452.6	1.9
Isoleucine	4.12	317	5.4	415.3	1.3
Phenylalanine + Tyrosine	8.47	446	9.3	489.5	1.9
Cystine + Methionine	8.15	479	5.7	335.3	1.7
Therionine	2.32	234	4.7	522.2	0.9
Histidine	2.37	148	2.2	137.5	1.6

*as reported by FAO/WHO (1985).

It could be noted that the chemical scores of lysine, leucine, sulfuric amino acids (methionine and cystine) and histidine are higher than those of whole egg (as a standard protein). Although the chemical scores of valine and aromatic amino acids are lower than those of whole egg, the different is slight (7.6 and 9.8% for valine and aromatic amino acids, respectively). On the other hand, the chemical scores of isoleucine and therionine of olive leaves are markedly lower than those of whole egg, since the rate of decrement was 23.5% for isoleucine and 55.2% for therionine.

c) Computed protein efficiency ratio and biological value

The data of C- PER and C- BV of olive leaves protein are given in Table (5) compared with those ofcasein as a reference protein. C-PER and C-BV of olive leaves were found to be 3.297 and 84.617, respectively. C-PER and C-BV of olive leaves showed to have higher values compared with casein (2.50 and 76.23, respectively), which in turn indicated that olive leaves protein have high nutritional value.

Table (5): Computed protein efficiency ratio (C-PER) and biological value (C-BV) of olive leaves compared with casein

Samples	C-PER	C-BV
Olive leaves	3.297	84.617
Casein* (reference)	2.500	76.230

*FAO\WHO (1991).

The high values of C-PER and C-BV in olive leaves protein can be attributed to the increase in the concentration of both leucine and tyrosine amino acids, the only two amino acids which were used for the calculation of C-PER, and consequently, C-BV, as well. Furthermore, it should be also taking into consideration that the cholesterol- lowering affect of dietary proteins is correlated to their contents of some amino acids, especially arginine, lysine and methionine, which play an important role in the process of lipogenesis **(Metwalli, 2005).**

a) Ratios between some amino acids and their relation with human health

Table (6) shows some amino acids ratios of olive leaves compared with casein. Data in this Table show that the methionine to glycine in olive leaves protein was zero because the methionine was not detected. According to the findings of **Sacki and Kirryama (1990),** methionine is hypercholesterolemic but glycine, as reported by **Sugiyama *et al*. (1993)**, is hypocholesterolemic. The ratio of methionine to glycine has a significant strong positive correlation with

serum cholesterol concentration and it is considered as an index for lowering the total cholesterol in blood **(Morita *et al.,* 1997)**. This means that olive leaves may play a role for lowering the total cholesterol in blood.

The lysine to arginine ratio (41.76), which is much higher than that of casein (1.78) as a result to high content of lysine and low content of arginine in olive leaves, is also correlated with serum cholesterol concentration as reported by **Sugiyama *et al*. (1993).** Moreover, **Yang *et al*. (2007)** observed a significant correlation between total serum cholesterol and leucine to isoleucine ratio, which is higher in olive leaves protein (2.4) than that of casein (1.04) as shown in Table (6).

Table (6): Some amino acid ratios of olive leaves, as compared with casein

Amino acids ratios	Olive leaves	Casein*
Methionine: glycine	0.00	1.72
Lysine: arginine	41.76	1.78
Leucine: isoleucine	2.14	1.04

As reported by *FAO\WHO (1991).

Total phenolic compounds content of olive leaves

Various solvents (95% ethanol, 70% ethanol, 99% methanol, and 70% methanol) for different extraction times (2, 4, 6, 8 and 24 hrs) were used to extract the phenolic compounds from olive leaves. Also, distilled water at 60^{o}C and 90^{o}C for 5 and 10 min was used for the same reason. The results were given in Tables 7 and 8. The results in Table 7 indicate that the effect of solvent concentration and type on extraction yield was remarkable and 70% ethanol and 70% methanol were more effective than 95% ethanol and 99% methanol. Moreover, 70% ethanol was the superior solvent for the extraction yield.

As for the effect of time on extraction yield, the results show that there was no certain correlation between increasing of time and yield of extraction. **Rafiee *et al.* (2011)** studied the effect of solvent type and extraction time on extraction yield of olive leaves and found that 50% ethanol gave the best extraction yield after 24 hrs, although the difference between 3 hrs and 24 hrs was not significant, comparing with 80% methanol and water. They also reported that there was no certain correlation between extraction time and extraction yield. Moreover, the optimal extraction time depended on solvent type and variety.

Table 7: Effect of solvent type and extraction time on extraction yield and total phenolics content of olive leaves (on dry weight basis)

Extraction time (hr)	Solvent type			
	95% ethanol	70% ethanol	99% methanol	70% methanol
Extraction Yield%				
2	13.2	20.6	9.0	16.4
4	24.0	22.4	18.6	24.6
6	15.8	18.6	13.0	18.4
8	14.0	20.4	14.4	18.6
24	19.4	24.6	19.8	23.4
Total Phenolic compounds mg GAE/g				
2	33.0	36.0	29.0	35.8
4	25.4	34.4	33.6	34.8
6	33.6	34.4	27.8	36.2
8	31.8	38.8	34.4	38.2
24	34.0	37.8	36.8	35.0

In respect to the effect of solvent type on the total phenolic compounds content, the results in Table (7) show that total phenolic compounds of olive leaves extracted using 95% ethanol ranged from 25.4 to 34.0 mg GAE/g and the highest amount was found with extraction time 24 hours. In case of using 70% ethanol, the total phenolic compounds content was higher than that extracted using 95% ethanol and ranged from 34.4 to 38.8 mg GAE/g and the highest amount was found with extraction time 8 hours. **Cavalheiro *et al.* (2015)** extracted the phenolic compounds from olive leaves of some varieties cultivated in Brazil using 60% ethanol for 5 hrs and found that total phenolic compounds ranged from 21.59 to 28.82 mg GAE/g dry sample. Also, **Abaza *et al.* (2011)** extracted the phenolic compounds from olive leaves of the Chetoi variety using 70% ethanol and 24 hrs of extraction and found total phenolic compounds of 24.36 mg GAE/g, which was lower than that in present study (37.8 mg GAE/g). This difference may be attributed to the variation of variety and cultivation region.

The results in Table (7) show also that the amount of total phenolic compounds extracted using 70% methanol was higher, in general, than that extracted using 99% methanol for the same extraction time. It is clear that 70% ethanol was best solvent for extraction of phenolic compounds from olive leaves comparing with other solvents. **Anwar *et al.* (2013)** used 100% ethanol, 80% ethanol, 100% methanol and 80% methanol to extract phenolic compounds from cauliflower. They found that each solvent system did vary significantly in their ability to extract phenolic compounds and the aqueous methanol was superior solvent. Moreover, they suggested that aqueous based organic solvents are superior to recovering a

higher extraction yield from cauliflower and aqueous methanol was more significantly efficient than aqueous ethanol.

Table 8: Effect of temperature and extraction period on extraction yield and total phenolic compounds content of olive leaves using water (on dry weight basis)

Extraction time (min)	Temperature	
	60 °C	90 °C
Extraction yield		
5	23.2	27.6
10	22.4	20.4
Total phenolic compounds mg GAE/g		
5	37.2	38.2
10	36.8	39.2

Regarding the effect of extraction time on total phenolic compounds, the results in Table (7) reveal that there was no certain correlation between the total phenolic compounds extracted from olive leaves and extraction time.

The results in Table (8) show the effect of water as a solvent at different temperatures (60 and 90°C) and different times (5 and 10 min) on extraction yield and total phenolic compounds content. From this Table, it could be noticed that slight difference between the content of total phenolic compounds extracted from olive leaves using water at both temperatures. Moreover, the extraction time had a slight effect on total phenolic compounds.

Comparing the effect of alcoholic solvents and the effect of water on total phenolic compounds, the results in Tables (7 and 8) indicate that ethanol 70% for 8 hrs and boiling water for 10 min gave the highest amount of total phenolic compounds (38.8 and 39.2 mg galic acid equivalent/g, respectively). **Coldsmith *et al.* (2015)** found that total phenolic compounds content of olive leaves extracted using water at 90°C was nearly similar to that extracted with 50% ethanol and 50% methanol.

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الملخص العربي

التقييم الكيميائي والغذائي لأوراق الزيتون وإختيار الظروف المثلي لإستخلاص المركبات الفينولية منها

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تمت هذه الدراسة بهدف تقييم الخواص الكيميائية والغذائية لأوراق أحد أصناف الزيتون المنزرعة في مصر وهو صنف كلاماتا. كذلك تمت الدراسة بهدف معرفة أنسب الظروف لإستخلاص المركبات الفينولية من هذه الأوراق. تم تقدير التركيب الكيميائي وكذلك تقدير العناصر المعدنية في أوراق الزيتون قبل السلق وبعد السلق علي درجة حرارة 90 مئوية لمدة 10 دقائق وذلك لأن الشائع هو إستخدام المستخلص المائي للأوراق وتقدير التركيب الكيميائي وتركيب المعادن بعد غلي الأوراق قد يعطي فكرة عن قيمتها الغذائية ومدي جدوي الإستفادة منها. أيضا تم تقدير الأحماض الأمينية لأوراق الزيتون. تم إستخلاص المركبات الفينولية الكلية بإستخدام ظروف مختلفة مثل مذيبات مختلفة ومدد إستخلاص مختلفة وتم تقدير المحتوي الكلي للمركبات الفينولية المستخلصة. والنتائج المتحصل عليها تتلخص في الآتي:

تحتوي أوراق الزيتون الكاملة (قبل السلق) علي كميات بروتين ومستخلص إثيري ورماد 10,6 و 7,9 و 6,8% بينما تحتوي الأوراق بعد السلق علي 10,7 و 8,1 و 6,7% علي التوالي. أوراق الزيتون مصدر غني بالألياف الخام والعناصر المعدنية. الكالسيوم هو العنصر السائد ويليه البوتاسيوم. كذلك تعتبر أوراق الزيتون مصدر جيد للحديد. تحتوي أوراق الزيتون علي كل الأحماض الأمينية الأساسية (فيما عدا المثيونين) وبكميات مناسبة حيث يصل إجمالي الأحماض الأمينية الأساسية 57% والليسين هو الحمض الأميني السائد إذ تبلغ كميته 17,12جم لكل 100جم بروتين. كفاءة البروتين والقيمة الحيوية المحسوبة لبروتين أوراق الزيتون تفوق مثيلاتها في الكازين مما يدل علي إرتفاع قيمتها الغذائية.

الإيثانول بتركيز70% لمدة 8 ساعات والماء المغلي (90 درجة مئوية) لمدة 10 دقائق هما الأكفأ في إستخلاص الفينولات من أوراق الزيتون حيث أعطت أعلي محتوي كلي للفينولات (38,8 و 39,8ملجم مكافئ حمض الجاليك/جم عينة جافة, علي التوالي). لا توجد علاقة منتظمة بين وقت الإستخلاص وكمية الفينولات الكلية المستخلصة من أوراق الزيتون.