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CHEMICAL COMPOSITION OF SEEDS AND OIL OF BORAGE (*Borago officinalis*).

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ABSTRACT

Chemical composition of borage (*Borago Officinalis*) seeds were determined and the results revaled the percentage of moisture , ash , crude protein , crude lipids , crude fiber were 3.9 ,15.9 ,22.8 , 30 ,and 4.3 % .Also seeds contain low content of total phenols 0.4 % . At the same time seeds contain total hydrolysable carbohydrate of 21.4 %. Crude oil was extracted from seeds and fractonted by gas liquid chromatography (GLC) and found that it has high amount from unsaturated fatty acids and low content from satureted one·s. Also, constantse of oil were determined and found that oil has high value of iodine and saponification , low value of acid and peroxide value.

Keywords : Borago , Protein , Crude fiber ,Fatty acids composition , Unsaponifiable matters.

INTRODUCTION

Borage (*Borago Officinalis.,* (LINN) belonging to family boraginaceae and the bright blue , star-shaped flowers make borage one of the prettiest herb plants , thought the dark green leaves are rather plain . The flavor of the leaves resembles that of cucmber . The plant will grow to a height of about 18 inches , and spread about 12 inches . This hardy annual has a messy, straggling habit . It is a natine of northern Europe ,and grows well in the temperate regions of North America thus the parts used leaves and flowers. (Earle, *et al*. 1959; Kleiman, *et al.* 1964. and Simon, *et al*. 1984) Borage contains potassium and calcium , combined with mineral acids . The fresh juice affords 30 percent , the dried herb 3 percent of nitrate of potash . The stems and leaves supply much saline mucilage , which when boiled and cooked like wise deposits nitre and common salt . It is to these saline qualities that the wholesome invigorating properties of borage (Kapoor &Klimaszewski 1999; and Kast, 2001).

Culinary uses of borage are flowers and leaves are the traditional decoration for ginbased summer cocktails , and may be set in ice cubes to garnish other drinks . The flower and young leaves may be used to garnish salads dips and cucumber soups, candied borage flowers make attractive cake decorations also chopped leaves can be added to soups and stews during the last few minutes of cooking but the medicinal use of borage are because it is a tonic plant for the adrenal glands , borage provides an invaluable support for a stressful lifestyle ,A tea made with borage helps to reduce fevers and case chest colds and an infusion of borage acts as a galactogogue , promoting the production of milk in breast feeding mothers (Chrubasik and Roufogalis 2003) .

Finally borage makes an excellent facial steam for improving very dry sensitive skin . Purified borage oil contains a laeger concentration of gamma linolenic acid 23 **%** thus a higher dose of gamma linolenic acid can be administered in fewer capsules for medicinal uses . Also seed oil of borage had an unsaponificable metter rate of 0.74 % and borage contained triterpene alchohol compounds such as cycloarternol and 24 –methyllene cyclo arternol (Ntsourankoua and Artaud 1997) .

MATERIALS AND METHODS

Source of samples :-

Seed samples of Borage (*Borago Officinalis)* were collected from plants cultivated in bee research station , faculty of Agriculture , cairo university . during summer seasone (2005 and 2006) . The seed were air dried and meiled to give dried powdered then subject to the following . general analysis as follow : Moisture , ash , lipids , crude proteins (Nx 6.25) and crude fiber were determined according to A.O.A.C (2000) methods , total phenolic compounds were determined according to (Swain and Hillis 1959) .Total hydrolysable carbohydrates and total soluble sugars were determined according to the method of (Dubois *et al*. 1956). Reducing sugars were determined by the method reported by (Bernfedld 1955) and nonreducing sugars was calculated by diference .

Lipid extraction :-

Total lipids were extracted from borage seeds by the method of (Folch *et al.* 1957) using a mixture of choroform : methanol (2 : 1).

Fatty acid composition : -

Portions from the extracted lipids were converted into their fatty acid methyl esters (FAME) according to the method of (Egan *et al*. 1981). Fatty acid composition of the prepard samples was performed by Gas Lipuid Chromatography (Schimadzu Gas chromatograph Model 4 CM , Tkyoto ,Japan) equipped with a Flame ionization Detector (FID). A wide bore (id = 0.5 mm) chrome packed glass column was used (sP 2340 silica). The chromatigraphic conditions were as follows : Injection port tempreature , 270 ^{o}C , flame ionization detector (FID), 270 ^{o} C initial oven temperature 150 ^{o} C rising to 240 ^{o}C / min . The carrier gas used was nitrogen at flow rate of 25 ml / min . Standard FAME (Nu – check – prep, Elyssia , MN , USA) were routinely chromatographed . The fatty acid composition of the samples was identified by comparison their retention time with the retention times of known stantards

Saturated and unsaturated fatty acids were identified , and the rotio of TU / TS fatty acids was calculated .

Fractionation of unsaponifiables matters :-

The unsaponifiables metters were also fractionated on a coild glass column (2.8 m×4 mm) packed with diatomide C. (100-120 mesh) and coated with 3% OV-17. The oven temperature was programmed at 10 ºC/min from 70^{o} C to 270 ºC , then isothermally at 270 ºC for 25 min and nitrogen flow rate was30 ml/ min .

Detector, injector temperature, and hydrogen, air flow rates were generally 300 ºC, 280 ºC, and 33ml, 330ml/min, respectively. Peak identification was performed by comparison the retention time (RT) of each compounds with those of standard materials .

The linear relationship between log retention times of the standard hydrocarbons and the number of carbon atoms of these comopunds was

used to characterize the unavaible authentic hydrocarbons .Peak area was measured by using a computing integrator (PU 4810 ,Philips).

Chemical constants of oil :-

Acid , peroxide , iodine , ester , and saponification values were determined according to (A.O.A.C. 2000) methods .

Statistical analysis : -

The data obtained from the present study were subjected to statistical analysis using standard deviation (S.D) accoribed by (Sendecor and Cochran 1980) .

RESULTS AND DISCUSSION

Chemical Compsition of Borage seeds :-

The chemical composition of borage seeds samples were analysed and the obtained results are illustrated in Table (1).Analysis of borage seeds samples shows that the levels of moisture , ash crude protein , crude lipids , crude fiber , total phenols and total hydrolysable carbohydrates were 3.9,15.9 ,22.8 ,30 , 4.3 , 0.4 and 21.4 % respectively. These deta demonstrate that the main constituent was crude lipids then crude protein and total carbohydrates . These data are in harmony with those obtained by (Ntsourankoua and Artaud 1997) .They found that borage seeds rich with oil content and purified borage oil (derived from *Borago officinalis*) contains a larger concentration of gamma – linolenic acid 23 % .

Table(1): Chemical Compsition (%) of borage seeds samples (on fresh weight basis)

Constaituents	
Moisture	3.9
Ash	15.9
Crude Protein	22.8
Crude Lipids	30
Crude Fiber	4.3
Total phenols	0.4
Totale hydrolysable carbohydrates	21.4
Totale soluble sugars	1.2
Rrducing soluble sugars	0.11
Non Rrducing soluble sugars	1.09
Non soluble sugars	19

Also (Yang *et al* . 2002) showed that borage is a speciality for oil which had high content of crude oil (33 %) and crude protein (28 %) and at the same time (Steve Blake 2004)
found that chemical composition of borage meal contain 14%ash , crude protein 33 % ,23 % acid detergent fiber and 35 % neutral detergent fiber .

Fatty acid composition in oil of borage seeds:-

Fatty acid composition is shown in Table (2) .It can be observed that oil of borage seeds contained palmetic acid as the most abundant saturated fatty acid 11.97 % then stearic acid 9.60 % .The unsaturated fatty acids present were linoleic 32.40 % , oleic acid 22.68 % and linolenic acid 18.49 %. The ratio of TU /TS reached 3.6 and the total saturated fatty acid was 21.62 % and the total polyunsaturated fatty acid was 78.38 %.

Table (2):-Fatty acids composition of oil from borage seeds

Constants fatty acids % w /w of total fatty acids	
Fatty acids composition	
Sturated fatty acids	
Palmitic $C_{16:0}$	11.97
Margaric $C_{17:0}$	0.05
Stearic $C_{18:0}$	9.60
Total	21.62
Unsaturated fatty acids	
Palmitoleic $C_{16:1}$	0.33
Oleic $C_{18:1}$	22.68
Linoleic $C_{18:2}$	32.40
Linolenic $C_{18:3}$	18.49
α-Parinaric $C_{18:4}$	0.088
Arachidonic $C_{20:4}$	0.18
Eicosapentaenoic $C_{20:5}$	4.16
Total	78.38
UNSAT /SAT ratio	3.60

This results are agreed with those of (Takahashi *et al*. 2000) . They showed that borage oil containing 47 % gamma linolenic acid and (Melek *et al*. 2003) showed that borage oil (GLA) content 22% is one of the most important and commercially available sources of GLA .In this respect

(Martinez *et al.* 2004) found that *B. officinalis* oil contining 16 : 0 of 9.6 % , 18 : 1 of 14.51 % , 18 : 2 of 41.0 % and 18 : 3 of 22.7 % respectively.

Unsaponifiable matters of borage seeds oil : -

Data in Table (3) show that unsaponifiable metters of oil contining *n*-octacosane 28 : 0 (82.35 %) ,*n*-docosane 22 : 0 (6.309%) ,18 : 0 (3.76%) and *n*-hexadecosane 16 : 0 (3.65 %) and 18 compounds ranged from (0.59 % to 3.19 %).In this respect (Nisourankoua and Artaud 1997) found that borage contained cycloarterol (81.0 %) and 24 -methylene cycloarternol (19.0 %) Theses triterpene alcohol compounds may by metaboiled to unsaponifiable metters through metabolism cycles inside the plant and these compounds give the oil bad odor .

Table (3):-Unsaponifiable metters composition of borage oil

Constaituents	
n –Pentadecane C15 :0	1.915
n-Hexadecane C16 :0	3.650
n-Heptadecane C 17 :0	2.006
n-Octadecane C 18 :0	3.76
n- Nonadecane C19 :0	1.76
n-Eicosane C 20 :0	0.902
n- Henicosane C 21 :0	1.144
n- Docosane C 22 :0	6.309
n- Tricosane C23 :0	0.904
n-Tetracosane C 24 :0	1.15
n- Pentacosane C 25 :0	1.596
n- Hexacosane C 26 :0	0.59
n- Heptacosane C 27 :0	1.33
n-Octacosane C28 :0	82.35
n-Nonacosane C29 :0	0.91
n-Tricotane C 30 :0	3.19
n-Heeitricontane C 31 :0	0.75
Other non detected	5.323

Constants of borage oil : -

Acid , saponification , iodine , peroxide and ester values were determined in oil and the results are presented in Table(4).

Table (4) : -Oil constants from borage seeds

Oil constant	
A.V. (mg KOH / g oil)	0.5
S.V. (mg KOH / g oil)	192
P.V. (meq . peroxides / kg oil)	4.7
I.V. (mg / 100 g oil)	135
E.V	191.5

And showed that oil has high iodine value (135) due to high conctent from unsaturated fatty acids (78.38 %) and saponification value (192) due to high moleculae weight but low value from free acid value and peroxide value dut to have low amount from free fatty acids and oxagented compounds. There results are agreement with (Martinez, *et al*. 2006).

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التركيب الكيماوي لبذور وزيت خبز النحل

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يعتبر نبات خبز النحل من النباتات العشبية المزهرة الهامة التي لها العديد من الاستخدمات الغذائية والطبية ونظرا للون الزهرة المميز ادي الي انجذاب نحل العسل اليها بشدة فلهذا تم اجراء تحليل كيماوي لهذا النبات بغرض القاء الضوء عليه وتحديد الاهمية الخاصة به وقد وجد ان الجزء المستخدم من هذا النبات الاوراق والازهار والبذور وقد تم اجراء تحليل كيماوي للبذور فوجد ارتفاع محتواها من الزيت والعناصر المعدنية والكربوهيدرات ووجد ان الزيت عالي في محتواه من الاحماض الدهنية الغير مشبعة خاصة الاحماض التي من نوع اوميجا 3 بالاضافة الي العديد من المواد الغير متصبنه التي يحتمل ان تكون مسئوله عن رائحة الزيت الغير مرغوبه التي تؤدي الي استخدام في الاغراض الطبية وليس الاغراض الغذائية .