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CHEMICAL AND BIOLOGICAL STUDIES ON LOCAL AND IMPORTED *NIGELLA SATIVA* L. SEEDS AND ITS DEFATTED MEAL (CAKE)

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ABSTRACT

Egyptian (local or balady) and imported *Nigella sativa* L. seeds and its defatted meal (cake) were analyzed for chemical composition Proteins, fats, carbohydrates, fibers, and ash in local seeds were: 21.44, 36.22, 22.00, 15.82 and 4.55% respectively (in dry weight bases), while in imported seeds they were 20.55, 35.38, 26.28, 11.67 and 4.11% respectively. On the other hand in defatted local seeds the same components were 28.34, 14.5, 40.12, 12.54 and 4.87% respectively while defatted imported seeds they were 29.65, 13.86, 42>15, 12.88 and 4.95% respectively. Seeds and its cake contain aproximate amounts of amino acids compared with WHO/FAO pattern except for lysine which was 5.8 in WHO/FAO pattern while it was 2.66, 2.92, 3.56 and 4.18 in balady and imported seeds and its cakes respectively. Nigella seeds and its cake contain different quantities of minerals Ca, P, Fe, Zn, Mg and Cu. The biological evaluation of protein (PER and NPR) was studied. PER values were 1.45, 1.66, 1.89 and 2.03 of balady, and imported seeds and its cakes respectively, while NPR values were 1.86, 1.95, 2.05 and 2.15 respectively.

INTRODUCTION

Nigella sativa L. seeds are small, black and possess aromatic odour and tast, Salama (1973). The plant is cultivated in Egypt, and known under different arabic names: Habbah Sowda, Kamun Aswad, Habbet El Baraka.

The seeds on account of their aromatic nature, are used as a spice in cooking particularly in Italy and Southern France. Jonson (1981), reported that whole or crushed seeds are used in or on bread as a flavouring agent in Egypt, India, Turkey and USSR. El-Komey, (1996), mentioned that these seeds are used by Egyptians as a diuratic, carminative and flavoring agent, by Syrians for cheese flavoring and by the Armenians for bakery products , and cookies.

Nigella sativa seeds are used almost entirely for edible and medical purpose, Abd-El-Maksoud *et al.* (1996), mentioned that in Arabian folk medicine the whole seeds alone or in combination with honey or garlic are promoted for treatment of hypertension. Its oil used for medical purposes such as treatment of asthma, antibacterial, antifungal (Islam *et al.* 1989, and Ustun *et al.* 1990).

Chemical composition of nigella seeds was detected previously by Gad *et al.* (1963), Salama (1973), Babayan *et al.* (1978) and El-Faham (1994). Salomi *et al.* (1992) studied the chemical composition, nutritive value and pharmacological activities of *Nigella sativa* seeds.

The aim of this work is to investigate the chemical composition, amino acids, minerals and nutritive value of Egyptian *Nigella sativa* seeda (called balady or local) and its defatted meal (cake) in comparative with imported seeds and its cake.

MATERIALS AND METHODS

Materials:

Nigella sativa L. seeds (Balady and imported) were obtained from local herb grocery. The seeds were cleaned and ground. The defatted cake of balady and imported seeds were obtained by mechanical cold pressing of the seeds with screw press machine.

Methods of analysis:

Chemical analysis of seeds and cakes including proteins, fats, ash, crude fibers, and moisture were determined according to A.O.A.C. (1995). Total carbohydrates were determined according to Dubois *et al.,*(1956). Amino acids content was determined using amino acid autoanalyzer according to Babayan *et al.* (1978). Minerals content was determined using a Perkin Elimer atomic absorption spectrophotomer (Plasma 400) according to Issac and Kerber (1971).

Protein efficiency ratio (PER) and net protein ratio (NPR) were done according to Nielsen (1998).

Forty two male albino rats weighed from 72-85 gm, 45 days age were obtained from NODCAR farm were divided into six groups. The basal diet was prepared according to A.O.A.C. (1995). The dried powder of Nigella sativa seeds (Balady and imported) and its cake were added to the expense of starch to produce the desired level of protein which was 10% level.

Diet and water were given for four weeks, food intake was recorded daily, and body weight of every rat was recorded weekly. PER and NPR were calculated according to the following equations:

$$\text{PER}^{*} = \frac{\text{Gain in body weight of test animal (g)}}{\text{Protein consumed (g)}}$$

$$\text{Corrected PER} = \text{Found PER of sample x } \frac{\text{PER of casein standard (=2.5)}}{\text{PER of casein in test}}$$

$$\text{NPR}^{*} = \frac{\text{Gain in b.w. of test animal + loss in b.w. of animals of free protein diet}}{\text{Protein consumed by test animals}}$$

*Nielsen (1998)

RESULTS AND DISCUSSION

a- **Chemical composition:**

Proximate chemical composition in table (1) shows that the percentages of proteins, fats, carbohydrates, crude fibers, and ash in balady type of *Nigella sativa* L. seeds are 21.44, 36.23, 22.0, 15.82 and 4.55% respectively and their of imported seeds are 20.55, 35.38, 26.28, 11.67 and 4.11 respectively. These percentages increased in defatted seeds (cake) as shown in table (1). Proteins as example increased in cake by 45% after seeds defatted. These results are in agreement with those of Babayan *et al.,* (1978) who reported that *Nigella sativa* L. seeds contained proteins, fats, carbohydrates, fibers and ash in percentages of 21.26, 35.49, 33.96, 5.50 and 3.77% respectively. El-Faham (1994) found that the same above components were 21.84, 36.68, 19.56, 16.18 and 4.27% in nigella seeds and were 32.52, 4.13, 26.32, 13.56 and 4.24% in nigella cake which mean that protein increased by 49% after defatted.

Table (1): Chemical composition of *Nigella sativa L.* seeds and its defatted meal (cake) (on dry weight basis).

	Balady seed %	Imported seed %	Balady cake %	Imported cake
Moisture	5.58	5.46	5.67	5.82
Crude proteins	21.44	20.55	28.34	29.65
Crude fats	36.22	35.38	14.50	13.86
carbohydrates	22.00	26.28	40.12	42.15
crude fibers	15.82	11.67	12.54	12.88
Ash content	4.55	4.11	4.87	4.95

b) Amino acids composition:

Amino acids content in *Nigella sativa* L. seeds and its cake are shown in Table (2). It is clear that amino acids content in balady seeds and its meal was highest in quantity than that in imported seeds and its meal except valine and lysine. From the same table some essential amino acids, threonine (in cake only), valine, isoleucine and histidine increased in nigella seeds and its cake than WHO/FAO pattern (1985) while decreased in phenylalanine and lysine and may be similar in leucine compared with WHO/FAO pattern. On the other hand, from table (2) essential amino acids especially in defatted nigella meal were higher than that in wheat (from literature) especially in lysine, which was 3.56, 4.18 gm/100 gm protein in defatted meal of balady and imported nigella seeds. Lysine content in wheat was 2.7 gm/100 gm protein.

Table (2): Amino acids content of *Nigella sativa* L. seeds and defatted cakes (gm/100 gm).

	Balady seeds	Imported seeds	Balady cake	Imported cake	WHO/FAO * pattern	Wheat**
Threonine	3.35	3.07	4.52	3.91	3.4	3.33
Valine	4.28	4.48	5.73	5.86	3.5	4.3
Isoleucine	3.26	2.97	4.38	3.84	2.8	4.0
Leucine	5.36	4.87	7.24	6.20	6.6	6.7
phenyl alanine	4.15	3.11	4.45	4.40	6.3	5.3
Lysine	2.66	2.92	3.56	4.18	5.8	2.7
Histidine	2.14	2.04	2.98	2.59	1.9	2.1
Arginine	6.29	4.26	8.44	5.96	-	4.3
Aspartic acid	7.55	6.96	9.50	8.93		
Serine	3.50	3.16	4.73	4.04		
Glutamic acid	17.48	16.50	23.40	21.16		
Proline	4.28	3.84	5.75	4.85		
Glycine	4.84	4.28	6.49	5.49		
Alanine	4.28	3.41	5.86	4.38		
Tyrosine	2.42	2.14	3.25	2.76		

*** WHO/FAO pattern (1985).**
**** Matz, (1969).**

c- Minerals:

Data in table (3) show that minerals content in *Nigella sativa* L. seeds and its cake, imported nigella seeds is equal twice of P, Zn and Cu while increased in Fe and Ca and similar quantity of Mg content compared with balady seeds. On the other hand, balady nigella cake contains increased quantity of Fe, Ca, P and Mg and similar quantity of Zn and Cu compared with imported deffated seeds. The quantity of Ca and Fe of nigella seeds did not agree with results of Babayan *et al.,* (1978) which were 1060 mg and 14 mg/100 gm dry matter respectively. On the other hand, El Faham (1994) found that Fe, Ca P,Zn and Mg contents were 25, 750, 580, 7.75, and 720 mg/100 gm dry nigella seeds respectively, while contents of the previous mentioned minerals were 41, 850, 300, 8.0 and 710 mg/100 gm dry nigella cake respectively.

Table (3): Mineral content of *Nigella sativa* L. seeds and its defatted meal (mg/100 gm sample on dry weight basis).

	Iron mg	Calcium mg	phosphorus mg	Zinc mg	Magnisium mg	Copper mg
Balady seeds	9.73	133.80	7.41	0.50	242.25	1.20
Imported seeds	12.88	153.20	15.15	0.98	239.75	2.41
Balady cake	30.53	212.00	26.74	0.86	464.00	1.68
Imported cake	26.22	204.20	11.25	0.81	383.90	1.66

d- Biological evaluation of protein:

Data in table (4) show the biological value of nigella seeds and its cake, where protein efficiency ratio (PER) of balady and imported seeds and its cakes are 1.45, 1.63 1.89 and 2.03 respectively compared

with 2.5 for casein standard protein. On the other hand, net protein ratio (NPR) of balady, imported seeds and its cakes are 1.86, 1.95, 2.05 and 2.15 respectively compared with 2.58 for casein. Data in table (4) indicate that PER and NPR of defatted seeds (cake) increased in values than seeds and approached of casein standard values. On the other hand, imported seeds and its cake have PER and NPR higher than those of balady seeds and cake.

CONCLUSION

The present study shows that balady and imported *Nigella sativa* L. seeds and its defatted meal contain good quantities of proteins, carbohydrates, fats (in seeds), crude fibers, amino acids and minerals. They have good protein quality especially defatted seeds. These results may be encourage to use nigella seeds and its cake for food supplementation, in nutraceutical foods or in animals feed.

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دراسة كيميائية وحيوية على بذرة حبة البركة المزروعة محليا والمستوردة وعلى الناتج المنزوع الدهن منها

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تم تحليل بذور حبة البركة المزروعة محليا وكذلك المستوردة من الخارج وأيضا تحليل الناتج منزوع الدهن من هذه البذور (الكسبة) من حيث محتواها من البروتين والدهون والكربوهيدرات والألياف والرماد حيث أتضح أن بذور حبة البركة المزروعة محليا تحتوي على المكونات السابقة بنسبة مئوية ٢١,٤٤ ، ٣٦,٢٣ ، ٢٢,٠٠ ، ١٥,٨٢ ، ٤,٥٥ % على الترتيب والبذور المستوردة على ٢٠,٥٥ ، ٣٥,٣٨ ، ٢٦,٢٨ ، ١١,٦٧ ، ٤,١١% على الترتيب والحبوب المحلية منزوعة الدهن على ٢٨,٣٤ ، ١٤,٥ ، ٤٠,١٢ ، ١٢,٥٤ ، ٤,٨٧ % بينما الحبوب المستوردة منزوعة الدهن تحتوي على ٢٩,٦٥ ، ١٣,٨٦ ، ٤٢,١٥ ، ١٢,٨٨ ، ٤,٩٥ % على الترتيب السابق.

وقد اتضح أيضا أن التحليل الكيماوي للبذور السابق ذكرها من ناحية محتواها من الأحماض الأمينية انها تتشابه في النموذج الخاص بمنظمة الفاو ما عدا الليسين الذي يقل فيها.

واتضح أيضا أن محتوى المصادر السابقة تحتوي على كميات مختلفة وعالية من عناصر الكالسيوم والحديد والفوسفور والزنك والماغنسيوم والنحاس.

وأتضح أيضا نتيجة التقييم الحيوي لبروتين بذور حبة البركة قبل وبعد نزع الدهون منها أن معدل كفاءة البروتين ومعدل البروتين الصافي بها معدل متقارب مع باقي الحبوب والبقوليات بالمقارنة بالكازيين . وعليه يمكن استخدامها كمدعم غذائي بروتيني وأيضا ضمن الأغذية العلاجية في مراحل النمو والمراهقة وأيضا المكملات الغذائية أو في علائق الحيوانات.

Table (4): Biological evaluation of *Nigella sativa* L. seeds and its defatted meal (cake).

	Mean of initial b.wt(gm)	mean of final b.wt(gm)	Gain in b.w. gm	mean of food intake gm	PER	Corrected PER	Gain in b.wt. gm	Food intake gm	Protein consumed gm	NPR*
Contol group	77	131.0	54.0	30.3	1.78	2.5	324	1818	181.8	2.58
Balady seeds	81	109	28.0	27.1	1.03	1.45	168	1683	168.3	1.86
Imported seeds	81	111.6	30.6	25.80	1.18	1.66	183.6	1685	168.5	1.95
Balady cake	85	110	35.0	25.9	1.35	1.89	210	1732	173.2	2.05
Imported cake	72	105.3	33.3	22.5	1.48	2.08	199.8	1604	160.4	2.15

*** Loss in b.w. of animals of free protein diet is 145 gm.**