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# NUTRIENTS CONTENT AND NUTRITIVE VALUE OF SOME GERMINATED AND NON GERMINATED LEGUMES

**Metwalli, O. M.** ; Laila M. Tawfeek**; E. A. Hussien*; Thanaa E. Hamed* and Enas S. Elseidy***

*** Food Sci. and Nutrition,Dept., National Res. Centre, Dokki, Giza, Egypt**

****Nutrition and Food Sci. Dept., Fac. Home Economics, Minufiya Univ.**

## ABSTRACT

The present work aimed at studying proximate composition, amino acid profile, and biological evaluation of nutritive value of cooked germinated and ungerminated chickpea and faba bean. Biological evaluation including body weight gain, total food intake, food efficiency ratio, protein efficiency ratio and corrected protein efficiency ratio was assessed in rats in comparison to casein diet. In addition, nitrogen content of rat carcass was determined. Results of proximate analysis of legumes showed that percentage protein, fat, fibers, moisture and calories were increased while percentage ash and Carbohydrates were reduced on germination of faba bean. In germinated chick pea, percentage protein, ash and moisture were higher while percentage fat, crude fibers, carbohydrates and calories were lower compared to ungerminated one. Germination of both legumes produced reduction in total essential amino acids. Germination of either legumes produced reduction in aspartic, threonine, leucine, isoleucine and arginine and increase in valine and tyrosine. Concerning the nutritive value; rats of the test groups that fed on germinated faba bean, germinated chickpea and ungerminated chickpea showed significant reduction in body weight gain, food efficiency ratio, protein efficiency ratio and corrected PER compared to control. Rats fed on ungerminated faba beans showed non significant change in the previous parameters compared to control. The nitrogen contents in rats carcass showed significant reduction in rats fed on ungerminated legumes compared to control fed on casein diet. Nitrogen contents in rat carcass of the group fed on germinated legumes showed non significant change compared to that of control. It could be that the germination of legumes produced increase in %protein and decrease in % carbohydrate. Essential amino acids were reduced on germination of legumes. Protein efficiency ratio of germinated faba bean, germinated chickpea and ungerminated chickpea diets were significantly lower than that of casein diet Rat carcass nitrogen of ungerminated but not germinated legumes was significantly lower than that of casein diet**.**

**Keywords** : Germinated , ungerminated , chickpea , faba bean , amino acids.

## INTRODUCTION

Chickpea seems to be an important source of protein in several developing countries *(*Singh *et al.,* 1991*).* Faba bean form an important part of diet in developing countries. They may be consumed in the form of immature tender pods, green mature seeds or as dry seeds after cooking *(*Askar*,* 1986*).* Macarulla *et al. (*2001*)* reported that rats fed on *Vicia faba* diets showed significantly lower body weight and energy intake than rats fed on casein diets. Generally, legumes have been reported to have low nutritive value due to low amounts of sulfur containing amino acids, low protein digestibility and the presence of antinutritional factors. Heat treatment is

usually conducted before the use of legumes in a human diet. This improves the protein quality by destruction or inactivation of the heat labile antinutritional factors (El – Adawy , 2002*).* Germination may enhance the nutritive value of legumes by inducing the formation of enzymes that eliminate or reduce the antinutritional and indigestible factors in legumes *(*Greiner *et al.,* 2001*).* Since the chemical composition of crops varies with crop cultivars, soil and climatic conditions of the area, it is imperative to study the chemical composition of some important food legumes (Chickpea and faba bean) as regard to their protein, amino acids and mineral contents in order to high light their nutritional significance *(*Iqbal *et al.,* 2006*).* The aim of the present research was to study the proximate composition, amino acid***s,*** *content and* nutritive value of germinated and ungerminated chickpea and faba bean.

## MATERIALS AND METHODS

**Materials**

**1- Legumes**

Two types of legumes, chickpea (*Cicer arietinum*) and faba bean (*Vicia faba*), leguminosae family were purchased from Agricultural Research Center, Giza, Egypt.

**2- Dietary Ingredients**

Corn oil, maize starch and sucrose were obtained from local market.

**3- Animals**

Rats weighed 55-60g. (Sprague Dawly) were used to assess protein efficiency ratio (PER) and corrected protein efficiency ratio (CPER). Animals were obtained from the Central Animal House. National Research Center. They were kept individually in wire bottomed cages at room temperature and relative humidity of about 55%. Food and water were supplied *ad-libitum*.

**Methods**

**1- Preparation of legumes**

- **Preparation of ungerminated legumes**

Faba bean and chickpea were soaked separately in tap water for 24 hours at room temperature. The legumes were removed and cooked with water at 100 $C^o$ for 28 minutes in case of faba beans and for 10 minutes in case of chickpea.

- **Preparation of germinated legumes**

Legumes were soaked in water for 24 hours followed by germination in moist cloth for 72 hours in dark at room temperature. Germinated faba bean and chickpea were cooked at 100$^o$C for 28 minutes and 10 minutes respectively. Both germinated and ungerminated cooked legumes were de hulled and dried in hot air oven at 50$^o$C for 24 hours. Dried legumes were reduced to powder form that pass through 40 mesh sieve.

**2- Chemical analysis of legumes**

The powdered germinated and ungerminated dry legumes were chemically analyzed.

**2-1** Moisture, protein, fat, crude fiber and ash were determined according to A.O.A.C (2000). Carbohydrates were calculated by difference

**2-2 Amino acids composition**

Amino acids composition was determined using amino acid analyzer LC 3000 Eppendorf Germany.

Conditions: flow rate, 0.2 ml/min, pressure of buffer from 0 to 50 bar, pressure of reagent, from 0-150, reaction temperature, 123$^{o}$C.

**3- Preparation of experimental diets**

**Diets:**

Different diets (formula 1,2,3,4&5) were prepared. The composition of the experimental diets is illustrated in Table (1). The salt and vitamin mixtures used in the diets were prepared according to Briggs and Williams (1963) and Morcos (1967). A mixture of oil soluble vitamins was administered orally in a dose of 0.1 ml/ rat/ week .

**Table (1): Different experimental diets.**

| Ingredients | Diets | | | | |
|---|---|---|---|---|---|
| | Test groups | | | | Control balanced |
| | 1 | 2 | 3 | 4 | 5 |
| Corn oil | 10 | 10 | 10 | 10 | 10 |
| Cellulose N.N | 4 | 4 | 4 | 4 | 4 |
| Salt mix. | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| Vitamin mix. | 1 | 1 | 1 | 1 | 1 |
| DL- methionine | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Maize starch | 36.865 | 29.412 | 30.114 | 29.639 | 44.149 |
| Sucrose | 18.433 | 14.706 | 15.057 | 14.819 | 22.075 |
| Dried germinated faba bean | 26.002(1) | | | | |
| Dried ungerminated faba bean | - | 37.182(1) | | | |
| Dried germinated chickpea | - | | 36.129(1) | | |
| Dried ungerminated chickpea | - | | | 36.84(1) | |
| Casein | - | | | | 15.076(2) |
| Total | 100 | 100 | 100 | 100 | 100 |

**1) Quantities of dried legumes that contain 10g protein.**

**2) Quantity of casein that contains 10g protein according to A.O.A.C ( 2000).**

**The experimental design**

This experiment was carried out to determine the protein efficiency ratio (PER) and corrected protein efficiency ratio (CPER) of the studied germinated and ungerminated legumes. The experiment was conducted on 30 growing experimental rats.The rats were divided into five groups, each comprised 6 rats. Rats of groups 1, 2, 3 &4 were fed on test diets 1, 2, 3and 4 respectively (Table 1). Rats of the fifth group were fed on balanced casein diet (diet5).

During the period of the experiment the food intake and the rats were weighed twice weekly. The feeding experiment continued for four weeks. After the end of experimental time. Total food intake, body weight gain , food efficiency ratio, protein efficiency ratio and corrected protein efficiency ratio were calculated according to the following equations**:**

**Food efficiency ratio (FER) = body weight gain /total food intake**
**Protein efficiency ratio (PER) = body weight gain /total protein intake**
**Corrected protein efficiency ratio (CPER) = PER of test diet × 2.5/ PER for casein**

At the end of the experiment, the rats were killed. The body cavities and skull were incised with sharp scissors and the carcass of each group was weighed and then dried to constant weight in a hot air oven at 105 ºC for about 3 hours. Water content of the rat carcass was calculated by difference between the carcass weight before and after drying to constant weight. Each dried carcass was then minced and blended in an electric mixer. The nitrogen content of each carcass was estimated according to A.O.A.C. (2000).

**Statistical Analysis of Data**

The results of animal experiment were expressed as the Mean ±SE. All nutritional parameters were analyzed statistically using student t. test.

## RESULTS AND DISCUSSION

**1-Chemical Analysis Of Legumes**

Chickpea and faba bean are considered as important legumes in the diets of developing countries due to their high contents of protein *(*Askar*,* 1986 and Singh *et al., 1991),* calories, minerals and vitamins *(*Iqbal *et al.*, 2006*).* During the present study chickpea and faba bean were germinated then cooked. Also the ungerminated legumes were soaked for 24 hours and cooked. Then both were chemically analyzed to study the changes in their nutrients contents due to difference in treatment.

**Proximate composition:**

Table 2 showed the proximate analysis of germinated and ungerminated legumes. It can be noticed that germination of faba beans produced increase of the percentage protein, fat and fibers and reduction of ash content. Germinated chickpea showed higher level of protein and ash than ungeminated one. While fat, fibers and carbohydrate contents of germinated chickpea were low compared to the ungerminated. The moisture contents of germinated legumes were higher than the ungerminated. On the other hand it can be seen that germinated faba beans have the highest content of protein and fibers among the studied treated legumes. Fat content was of the highest value in case of ungerminated chickpea. Germinated chickpea showed the highest content of ash. The highest percentage of carbohydrate was present in ungerminated faba beans. Calorific content of the studied legumes ranged from 346.9 to 374.7 calories per 100g legume. The highest calories belonged to ungerminated chickpea while the least was in case of ungerminated faba beans.

The distinguished feature of legume seeds laid in their high protein content and most legumes fell in the range of 20-30% protein *(*Wolf*,* 1977*).* However it has been cited by Genoves and Iajolo *(*2001*)* that protein content in legume grain ranged from 17 to 40%, which cover the range of protein content of the present studied legumes*.* The same auther reported that most legumes (other than soya beans) contained low percentages of fat which

ranged from 2 to 5% which was in agreement of faba bean in present data but not chickpea.

It has been reported by Sidky *(*1986*)* that cooked ungerminated chickpeas contained 11.25% moisture, 23.6% protein, 5.93% fat, 52.55% carbohydrate and 3.89% ash. This result was more or less similar to obtained result of ungerminated chickpea concerning the different parameters except for ash and fat. Also, chickpea has been shown by Rincon *et al. (*1998*)* to contain 41.1% - 47.4% carbohydrates and 21.7% - 23.4% protein. It has also been cited that chickpea contained from 20.92 to 26.20% crude protein, 4.10 to 6.18% crude fat, 56.19 to 60.50% total carbohydrates, 2.80 to 2.92% ash and 2.5 to 5.5% crude fiber *(*Hallab *et al.* 1974*,* El- Rify *et al,* 1986*,* Ulloa *et al,* 1988*,* Ahmed *et al,* 1990 and Mansour*,* 1996*).* The difference in the chemical composition of ungerminated legumes among literature and the present study may be due to difference in crop cultivars, soil and climatic conditions Previously, it has been cited that germination produced important changes in the chemical composition of legumes including carbohydrate, crude fibers, lipids and proteins *(*Khalil *et al.,* 2001*),* which coincided with the current study. Storage compounds and synthesis of structural proteins and cell components take place during germination. Secondary, such compounds as fibres and antinutritional factors changes differently during germination, this changes in nutrients and antinutrients during germination differ according to the type of legumes and the sprouting conditions such as time, temperature and light cycle *(*Sierra and Vidal - Va lverde*,* 1999*).*

**Table (2): Proximate analysis of germinated and ungerminated legumes (g/100g) and their calorific content (Calories/ 100g).**

| Parameter | Ungerminated faba bean | Germinated faba bean | Ungerminated Chickpea | Germinated Chickpea |
|---|---|---|---|---|
| Protein | 24.3 | 34.7 | 24.6 | 24.9 |
| Fat | 2.1 | 2.5 | 7.1 | 6.5 |
| Ash | 5.3 | 5.02 | 5.03 | 6.1 |
| Crude fibers | 1.01 | 1.2 | 0.8 | 0.7 |
| Carbohydrate | 57.7 | 46.8 | 53.1 | 51.8 |
| Moisture | 9.6 | 9.9 | 9.4 | 10.1 |
| Calorific content | 346.9 | 348.5 | 374.7 | 365.3 |

**Each parameter has been evaluated thrice and the obtained data are the means of three values.**

A study was carried out by El – Adawy (2002) showed that germination of chickpea produced an increase in crude protein and decrease in fat and carbohydrate which agreed with our present data. The increase in protein might be due to using of seed components and degradation of protein to simple peptides during germination process. However the decrease in fat and carbohydrate might be attributed to their use as an energy source in germination. However the study of El – Adawy (2002) showed no changes in ash percentage and an increase in crude fiber after germination which were not the case in our results.

Reduction of carbohydrate contents in germinated legumes, in the present study, may be due to the complete elimination of carbohydrates such

as raffinose, stachyose and verbascose as a result of germination. Germination decreases level of reducing sugars, sucrose and starch which might be due to hydrolysis to produce monosaccharides which are either used as an energy source during germination or dissolved out in water during germination period.

**Amino acids' profile of legumes**

Table 3 showed the amino acids content of germinated and ungerminated chickpea and faba beans. From the results of amino acids it can be noticed that generally germination of either of legumes produced reduction in aspartic, threonine, leucine, isoleucine, lysine and arginine and increase in valine and tyrosine. Germination of chickpea resulted in reduction of aspartic acid, threonine, glutamic acid, glycine, leucine, isoleucine, histidine, lysine, and arginine while it produced elevation in serine, alanine, valine, methionine, phenylalanine and tyrosine. Germinated faba bean showed reduced levels of aspartic acid, serine, threonine, alanine, methionine, leucine, isoleucine, phenyl alanine, lysine and arginine compared to the ungerminated. However germination of faba bean increased the contents of glutamic acid, proline, glycine, valine, tyrosine, histidine.

It has bean reported that biological value of legumes is not very high due to its poor contents of sulphur containing amion acids, (Methionine, cystine and cysteine). On the other hand legumes' protein has been reported to be rich in lysine (Davidson, et al., 1979 and farzana and khalil, 1999), as could be seen from the present results.

**Table (3): Amino acids contents of germinated and ungerminated legumes (mg/ g protein).**

| Amino acid | Germinated faba bean | Ungerminated faba bean | Germinated chickpea | Ungerminated chickpea |
|---|---|---|---|---|
| **1. Non essential amino acids** | | | | |
| Aspartic acid | 72.7 | 80.5 | 80.1 | 91.9 |
| Serine | 26.6 | 34.5 | 36.9 | 35.8 |
| Glutamic acid | 107.0 | 105.6 | 102.2 | 112.7 |
| Proline | 24.6 | 0.1 | 8.6 | |
| Glycine | 25.2 | 22.6 | 26.3 | 30.0 |
| Alanine | 28.5 | 36.4 | 51.1 | 42.6 |
| Tyrosine | 23.5 | 22.9 | 33.7 | 24.9 |
| Arginine | 29.4 | 38.2 | 43.5 | 49.8 |
| **Total** | **337.5** | **455.8** | **382.4** | **387.7** |
| **II. Essentail amino acids** | | | | |
| Threonine | 36.2 | 40.4 | 40.3 | 43.3 |
| Valine | 24.2 | 20.0 | 17.6 | 16.4 |
| Methionine | 1.1 | 23.5 | 2.6 | 0.5 |
| Leucine | 20.3 | 28.5 | 25.3 | 29.8 |
| Isoleucine | 40.3 | 47.5 | 49.0 | 55.6 |
| Phenylalanine | 2.1 | 6.8 | 11.8 | 4.9 |
| Histidine | 27.6 | 18.0 | 25.8 | 33.4 |
| Lysine | 24.2 | 39.2 | 32.7 | 41.4 |
| **Total** | **176** | **223.9** | **205.1** | **225.3** |

It is noted that the content of total essential amino acids were more or less equal in ungerminated faba bean and chikcpea as could be seen from table 3. As a matter of fact germination produced reduction in total essential amino acids of the studied legumes. This result may be due to dissolution out of the amino acids in water during germination period, or the use of amino acids during germination process for growth. Germination has been shown previously to reduce lysine (El - Adawy, 2002) which agreed with the present study. The same auther showed the increase of leucine while no change in valine was occurred after germination which did not coincide with our study.

In a study conducted by Kuo *et al.* (2004), *who found that* germination of phaseolus vulgaris increased alanine, and lysine and decreased glutamic acid, glycine, arginine and tyrosine with disappearance of histidine. Some of these results agreed and others disagreed with the present study according to legumes type. Kuo *et al.* (2004) also reported that in germinating phaseolus vulgaris, the proline content increased which coincided with the result of faba beans in the present study that showed very high increase in proline after germination.

**Biological Experiment**

**Nutritive value of legumes**

It would be claimed that the theoretical quality of protein would depend mainly on its essential amino acid pattern. However, it has been stated long ago (Jelliffe, 1979) that the utilization of amino acids by the body was affected also by calorie intake, by the relative quantites of carbohydrates and lipids, by the nature and quantitative distribution of minerals and by the absence or abundance of various vitamins. Therefore, further information such as biological data would be needed to evaluate the protein value of the studied germinated and ungerminated legumes. The obtained results were expressed in various terms including, weight gain, food efficiency ratio, protein efficiency ratio, corrected protein efficiency ratio and nitrogen content of rat carcass.

Table 4 clarified the different nutritional parameters of growing rats fed on balanced casein diet (control group) and rats fed on different legumes diets (test groups). Rats of test groups that fed on germinated faba bean, germinated chickpea and ungerminated chickpea showed significant reduction in final body weight, body weight gain, food efficiency ratio, protein efficiency ratio and corrected protein efficiency ratio compared to control. The least body weight gain, food efficiency ratio and protein efficiency ratio belonged to rats fed on germinated faba bean diet. Rats fed on ungerminated faba beans showed non significant reduction in final body weight, body weight gain, food efficiency ratio and protein efficiency ratio compared to control. This results reflect a reduction in nutritional value of faba beans was happened as affected by germination.

It was expected that protein efficiency ratio of legumes diet would be lower than that of control diet (casein contaning diet) which was due to their deficiency of certain essential amino acids as reported by Farzana and Khalil (1999). In the present study it could be noticed that germination of the studied legumes reduced their protein efficiency ratio and Food efficiency

ratio. Consumption of food intake also was reduced significantly in case of germinated faba beans compared to control group. While non significant change was noticed in total food intake consumed by rats fed on ungerminated faba beans compared to control. This result may reflect the presence of functional components that may produce satiety or appetite suppression on germination of faba beans. The same effect was noticed in germinated chickpea but with lower degree. Generally, legumes have been reported to have low nutritive value due to low amounts of sulphur containing amino acids and low protein digestibility (El-Adawy, 2002).

**Table (4):Nutritional parameters of growing rats fed on balanced diet (control group) and rats fed on different legumes diets (test groups).**

| Groups / parameters | Control group | Test group | | | |
|---|---|---|---|---|---|
| | | Germinated faba bean | Urgerminated faba bean | Germinated chickpea | Ungerminated chickpea |
| **Initial body weight (g)** | 49.917 | 50.35 | 50.067 | 49.9 | 49.922 |
| **Mean ± SE** | **±2.086** | **±**1.198 | **± 0.797** | **± 1.749** | **± 1.852** |
| **Final body weight (g)** | 140.833 | 95.167[e] | 130.767 | 108.15[e] | 113.283[b] |
| **Mean ± SE** | **±2.34** | **±9.215** | **± 4.137** | **± 2.899** | **± 1.884** |
| **Body weight gain (g)** | 90.917 | 44.817[e] | 80.7 | 58.25[e] | 63.362[e] |
| **Mean ± SE** | **±2.97** | **±8.988** | **± 4.244** | **± 1.949** | **± 1.771** |
| **Total food intake (g)** | 285.3 | 217.85[c] | 275.733 | 264.767[b] | 275.8 |
| **Mean ± SE** | **±5.171** | **±18.784** | **± 15.332** | **± 5.172** | **± 13.919** |
| **Food Intake g/ day** | 11.412 | 8.714[c] | 11.029 | 10.591[b] | 11.032 |
| **Mean ± SE** | **±0.207** | **±0.751** | **± 0.613** | **± 0.207** | **± 0.557** |
| **Food efficiency ratio** | 0.319 | 0.206[d] | 0.295 | 0.219[e] | 0.233[e] |
| **Mean ± SE** | **±0.008** | **± 0.029** | **± 0.015** | **± 0.005** | **± 0.014** |
| **Total protein intake (g)** | 28.533 | 21.785 | 27.573 | 26.477[b] | 27.58 |
| **Mean ± SE** | **±0.517** | **± 1.878** | **± 1.533** | **± 0.517** | **± 1.392** |
| **Protein efficiency ratio** | 3.187 | 1.995[d] | 2.948 | 2.199[e] | 2.327[e] |
| **Mean ± SE** | **±0.089** | **± 0.292** | **± 0.146** | **± 0.056** | **± 0.136** |
| **Corrected protein efficiency ratio** | 2.5 | 1.565[d] | 2.312 | 1.726[e] | 1.826[e] |
| **Mean ± SE** | **±0.069** | **± 0.229** | **± 0.115** | **± 0.044** | **± 0.107** |

**Values significantly differ from the control:**
**a: p < 0.05 b: p <0.025 c: p < 0.01 d: p < 0.005 e: p < 0.001**

However some authors claimed that germination of legumes may enhance the nutritive value of legumes through enzyme formation that may reduce the antinutritional factors (Greiner *et al.,* 2001), this suggestion opposed the reduction of nutritive value on germination. Although chickpea in present study were undertaken different treatments such as soaking, germination, dehulling and cooking that were reported to reduce antinutrients,

however it still has low nutritive value. Chickpea was reported to contain several antinutritional factors that decrease the protein utilization as proteases and amylase inhibitors, lectins, polyphenols, certain sugars, raffinose, stachyose and phytic acid (Singh *et al*., 1991). Vioque *et al* (1999) claimed that the only way to overcome antinutrients is by isolation of chickpea protein. Although germination may reduce antinutrients in legumes as reperted previously by *(*Bau *et al.,* 1997)*,* and increase the percentage protein as seen from the present study however it reduced ash (mineral contents in case of faba beans only) contents and essential amino acids as could be noticed from the current study. This might has a hand in the further reduction of protein efficiency ratio of the germinated legumes in the present study. Cooking treatment after soaking and germination of legumes in the present study have been reported previously to reduce antinutrients *(tannins and saponins)* more than germination *(*El– Adawy*,* 2002*).* So this may clarify some how the higher protein efficiency ratio of ungerminated compared to germinated. It has been also cited that germination and cooking reduced vitamins content in legumes. Cooking reduced riboflavin, thiamin, niacin and pyridoxine, where as germination reduced thiamine and niacin (El – Adawy*,* 2002*)* which may share in the reduction of PER of the studied legumes compared to casein. It has been reported that feeding *Vicia faba* diet produced reduction in body weight gain compared to casein diet *(*Macarulla *et al.,* 2001*).* This result agreed with the present results concerning germinated *Vicia faba* but disagreed with the results of ungerminated *Vicia baba*.

The nitrogen contents in the carcass of rats fed on the tested legumes diets and the control casein diet could be seen in table, 5. It is noticeable that rat carcass of the groups fed on ungerminated legumes showed significant reduction compared to control rats fed on casein diet. Nitrogen contents in rat carcass of the groups fed on germinated legumes showed non significant change compared to that of control. This clarified better protein utilization on germination of legumes. This result was not in agreement with the PER of the present results that showed that PER was higher in ungerminated than germinated legumes fed groups.

**Table 5: Nitrogen content in rat carcass of the different experimental groups.**

| Groups | Germinated faba bean | Ungerminated faba bean | Germinated chickpea | Ungerminatal chickpea | Control |
|---|---|---|---|---|---|
| Mean | 9.716 | 7.287 [e] | 8.571 | 8.676 [b] | 9.538 |
| SE | **± 0.826** | **± 0.153** | **± 0.451** | **± 0.097** | **± 0.169** |

**Values significantly differ from control:**
**a:p<0.05 b:p<0.025 c:p<0.01 d:p<0.005 e:p<0.001**

## Conclusion*:*

Finally, it could be concluded that the germination of legumes produced increase in %protein and decrease in % carbohydrate. Essential amino acids were reduced on germination of legumes. Protein efficiency ratio of germinated faba bean, germinated chickpea and ungerminated chickpea diets were significantly lower than that of casein diet Rat carcass nitrogen of

ungerminated but not germinated legumes was significantly lower than that of casein diet**.**

## REFERENCES

A.O.A.C (2000): Official Methods of Analysis of Association of Agricultural Chemists, Washington , D.C.

Ahmed, J . M .Emmam , A. S and Yassa, A .I.(1990). Formation of a protein rich food mixture for the young from locally produced ingredients . Zagazig. J. Agric. Res., 17 (4A) : 1227-1233.

Askar A. (1986): Faba beans *(Vicia faba (L.))* and their role in the human diet. Food Nutr. Bull., 8: 15-24

Bau H.M., Villanme C., Nicolas J.P. and Mejean L. (1997): Effect of germination on chemical composition, biochemical constitutes and antinutritional factors of soy bean (*Glysine max*) seeds. J.Sci. Food Agric., 73: 1-9.

Briggs G.M. and Williams M.A. (1963): A new mineral mixture for experimental rat diets and evaluation of other mineral mixtures. Fed. Proc., 22:261.

Davidson S., Passmoke R., Broc J.E. and Truswell A.S. (1979): Human Nutrition and Dietetics ($7^{th}$ ed). The English language book society and Churchill livingstone.

EL-Adawy T.A. (2002): Nutritional composition and antinutritional factors of chickpeas *(Cicer arietinum L.)* undergoing different cooking methods and germination. Plant Foods for Human Nutrition, 57: 83-97.

El-Rify, M. N., Abdel-Gawad ,A .S. and Youssef, M .K.E (1986) .Effect of roasting of chickpea ( *Cicer arietnum* ) on gross chemical composition, amino acid composition and phenolic acids content. Assiut. J. of Agric. Sci ., 17(3) : 351-357 .

Farzana W. and Khalil I.A. (1999): Protein quality of tropical food legumes. Journal of Science and Technology, 23: 13-19.

Genoves M.I. and Lajolo F.M. (2001): Atividade inibitoria de tripsina do feijao (*Phaseolus vulgaris* L): a valiacao critica dos metodos de determinacao. Archivos Latinoamericanos de Nutricao, 51(4): 386-394.

Greiner R., Muzquize M., Burbano C., Cuadrado C., pedrosa M.M. and Goyoaga C. (2001): Purification and Characterization of a phytate degrading enzyme from germinated faba bean *(Vicia faba var. Alameda*). J. Agric. Food Chem., 49(5): 2234-40.

Hallab, A.H.; Khatchadourian, H.A.and Jabr, I.(1974) .The nutritive value and Organoleptic properties of white Arabic bread supplemented with soybean and chickpea. Cereal Chem . 51 (2): 106-112 .

Iqbal A., Khalil I.A., Aleeq N. and Khan M.S. (2006): Nutritional quality of important food legumes. Food Chemistry, 97: 331-335.

Jelliffe D.B. and Jelliffe E.F. (1979): “Nutrition and growth” Plenum Press, New York.

Khalil M.M., Hayashi S. and Miyazaki Y. (2001): Effect of soaking, germination, autoclaving and cooking on chemical and biological value of guar compared with faba bean. Nahrung, 45(4): 246-50.

Kuo Y. H., Rozan P., Lambein F., Frias J. and Vidal- Valverde C. (2004): Effects of different germination condition on the contents of free protein and non–protein amino acids of commercial legumes. Food Chemistry, 86: 537- 545.

Macarulla M.T., Cesar M., Aranzazu M., Chavarri M., Angeles M., Alfredo J., Catherine N., Paul H. and Maria P. (2001): Effect of the whole seed and a protein isolate of faba bean *(Vicia faba)* on the cholesterol metabolism of hypercholesterolaemic rats. British Journal of Nutrition, 85: 607-614 .

Mansour E.H .( 1996) Biological and chemical evaluation of seed proteins as affected by germination, extraction and -amylase treatment .Plant Foods For human Nutr . 49: 271-282 .

Morcos, S.R. (1967): The effect of protein value of the diet on the neuroiogical manifestations produced in rats by B,B- iminodi propionitrile. Brit. J. Nutr. 21: 269.

Rincon F., Martinez B. and Ibanez M.V. (1998): Proximate composition and antinutritive substances in chickpea *(Cicer arietinum L.)* as affected by the biotype factor. J. Sci. Food Agric., 78: 382-388.

Sidky H.M. (1986): A Ph.D. Thesis: Formulation and evaluation of baby food mixtures. Faculty of Agriculture, Cairo University.

Sierra I. and Vidal–Valverde C. (1999): Kinetics of free and glycosy- lated B-6 vitamins , thiamin and riboflavin during germination of pea seeds. Journal of science and Food Agriculture, 79: 307 – 310.

Singh U., Subrahmanyan N. and Kumar J. (1991): Cooking quality and nutritional attributes of some newly developed cultivars of chickpea *(Cicer arietinum)*. J.Sci.Food Agric., 55: 37-46.

Ulloa, J .A.Valencia, M ,E ,and Garcia, Z .H . ( 1988) Protein concentrate from chickpea :Nutritive Value of a protein concentrate from chickpea ( Cicer arietinum) obtained by ultrafiltriation and its potential use in an infant formula . J .Food Sci . 53: 5, 1396-1398 .

Vioque R. S., Clemente A., Vioque J., Bautista J. and Millan F. (1999): Protein isolates from chickpea *(Cicer arietinum L.):* Chemical composition, functional properties and protein characterization. Food Chemistry. 64: 237–243.

Wolf W.J. (1977): Legumes: seed composition and structure. Processing into protein products and protein properties. In: “Food Protein”ed. Whitaker J.R. and Tannenbaum S.R. AVI Publishing Company INC Westport, Connecticut .

**المحتوى الغذائى والقيمة الغذائية لبعض البقوليات المنبتة والغير منبتة**

**أنسى محمد متولى* ، ليلى محمد توفيق **، عصام عبد الحافظ حسين** ، ثناء السيد حامد سيد* و ايناس صبرى الصعيدى***

*** قسم علوم الاطعمة والتغذية-المركز القومى للبحوث- الدقى– الجيزة**

****قسم التغذية وعلوم الاطعمة-كلية الاقتصاد المنزلي- جامعة المنوفية**

يهدف هذا البحث الى دراسة التغييرات التى يمكن أن تحدث فى التركيب الكيماوى والأحماض الأمينية والقيمة الغذائية للحمص والفول المنبت والغير منبت والمطهى .والتقيم الحيوى للقيمة الغذائية يتضمن تقدير وزن الجسم المكتسب ، المأخوذ الغذائى الكلى, نسبة كفاءة الغذاء، نسبة كفاءة البروتين ، نسبة كفاءة البروتين المعدلة فى الفئران. بالاضافة الى تقدير محتوى النيتروجين فى: rats carcass . ولقد أظهرت نتائج التحليل الكيماوى للبقوليات موضع الدراسة أن نسبة البروتين والدهون والألياف والرطوبة والسعرات الحرارية إرتفعت فى الفول المنبت بينما إنخفضت نسبة الرماد والكربوهيدرات. أما فى حالة الحمص المنبت فقد أظهرت النتائج إرتفاع نسبة البروتين والرماد والرطوبة بينما انخفضت نسبة الدهون والألياف الخام والكربوهيدرات والسعرات الحراية بالمقارنة بالحمص الغير المنبت. وتسبب إنبات البقوليات موضع الدراسة فى تقليل نسبة الأحماض الأمينية الأساسية وإنبات أى من البقوليات ينتج عنه إنخفاض فى تركيز حمض الأسبارتك والثريونين والليوسين والأيزوليوسين والأرجنين وزيادة فى تركيز الفالين والثيروزين. أظهرت نتائج تقدير القيمة الغذائية أن المجموعات المختبرة التى تغذت على الفول المنبت والحمص المنبت والحمص الغير المنبت إنخفاض معنوى فى وزن الجسم النهائى، وزن الجسم المكتسب، نسبة كفاءة الطعام، نسبة كفاءة البروتين، نسبة كفاءة البروتين المعدلة مقارنة بالمجموعة الضابطة السالبة التى تم تغذيتها على الوجبة القياسية (الكازين) ولقد أوضحت نتائج الدراسة أن المجموعة التى تغذت على الفول الغير منبت لم تظهر تغير معنوى فى وزن الجسم النهائى، وزن الجسم المكتسب، نسبة فاعلية الغذاء، نسبة فاعلية البروتين ونسبة فاعلية البروتين المعدلة بالمقارنة بالمجموعة الضابطة. أظهرت النتائج أن محتوى النتروجين فى rats carcass إنخفض إنخفاضا معنويا فى المجموعة التى تغذت على البقوليات الغير منبتة بالمقارنة بالمجموعة الضابطة السالبة التى تغذت على الكازين أما بالنسبة للبقوليات المنبتة فإن محتوى النتروجين فى الفئران لم يظهر تغيير معنوى بالمقارنة بالمجموعة الضابطة.

نستخلص ان إنبات البقوليات يتسبب فى زيادة نسبة البروتين ونقص نسبة الكربوهيدرات. تقل الأحماض الأمينية الأساسية الكلية فى حالة إنبات البقوليات .تنخفض نسبة كفاءة الغذاء للفول المنبت والحمص المنبت والغير المنبت انخفاضا معنويا عن المجموعة التى تغذت على الوجبة القياسية (الكازين). نسبة النتروجين فى تجربة rats carcass التى تغذت على البقوليات الغير منبتة كانت أقل من المجموعة التى تغذت على (الكازين).

**قام بتحكيم البحث**

**أ.د / لويس كامل تادرس** — **كلية الزراعة – جامعة المنصورة**

**أ.د / سحر يوسف العقبى** — **المركز القومى للبحوث**