Effect of processed chickpea on blood glucose and cholesterol levels of the experimental animals.

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Abstract

Chickpea is considered an important legumes due to its highly protein content. Different processing treatments of chickpea were conducted, i.e., germination, soaking and cooking. The above mentioned treatments resulted in significant differcens in the chemical composition of these treatments. Performance experimental animals of these treatments. Rats were injected with streptozotocin (15mg/kg body) to induce hyperglycemia. Due to feeding germinated, soaked and cooked chickpea, an increase in body weight, was found being 82.48, 83.5 and 99.29% respectively compared to the control. Meanwhile, hyperglycemic animals showed a decrease about 2.64% compared with control. The ratio of liver, kidneys and brain weight to body weight showed a significant decrease for all groups except that of hyperglycemic control, which showed, a significant increase compared with normal control. The experimental animal fed diet containing processed chickpea meal resulted in decreasing serum glucose and cholesterol for diabetic rats compared with control.

INTRODUCTION

The Chickpea (*Cicer arientimum* L) is an important source of protein in several developing countries. Chickpea is considered the second in cultivated area and the third in production of dry beans and peas. Lombardi-Boccia *et al.*, (1991) found that the contents of moisture, protein, fat, soluble carbohydrate, starch, ash and total dietary fiber of chickpea flour were 9.9, 22.7, 6.2, 6.2, 35.0, 3.4 and 13.2%, respectively. Jood *et al.*, (1986) mentioned that chickpea is the good choice not only for nutrition, but also for its potential role in diabetes and hyperlipidimia cases which has received attention recently. They mentioned that, chickpea seeds contained

several components considered as hypoglycemic agents. Morita *et al* ., (1997) found that the growth, food intake, body weight gain and food efficiency ratio of rats fed on chickpea were relatively higher than that fed on casein diet. Dilawari *et al* ., (1987) found a more significant decrease in blood glucose concentration when carbohydrate was given in form of legumes (rajmoh, green gram and channa) than when given as cereals (rice, wheat) or glucose .Panlasigui *et al* ., (1995) reported that the blood sugar response to all legumes was significantly low compared to bread, and also they recommended that legumes could be added to the list of foods for diabetic and hyperlipidemic.

Gabr (1998) found that hyperglycemia was associated with significant increase in total cholesterol relative to normal control. The author recommended that feeding chickpea may correct these metabolic disturbances significantly and values are become comparable with control group. The present investigation aimed at studying the biological effect of processed chickpea seeds as hypoglycemic agents.

MATERIALS AND METHODS

1- Chickpea seeds (*Cicer areietinum* , var .Giza 2) were obtained from field Crops Inst, A.R.C. Giza Egypt.
2- Animals: Thirty (30) adult male albino rats were obtained from the Ophthalmology Research Inst. Giza, Egypt, weighed (140+5gm) were used in this study.

Processing of chickpea seeds:

Soaking, germination and cooking of chickpea were conducted according to the methods described by Jood *et al* (1986) as follows: Chickpea seeds were soaked in tap water (1.5w/v) for 12hr at room temperature, then dried at 55°C and milled. Another portion of the soaked chickpea seeds were left to germinate in sterile Petri dishes limed with damp filter papers at 25°C till sprouting, then dried and milled. For cooking chickpea seeds, water was added to seeds in a ratio of 1: 7 (w/v), then cooked on a hot plate until softening, then dried and milled.

Chemical analysis:

Moisture, crude protein, oil, fiber and ash were determined in raw, soaked, germinated and cooked chickpea seeds according to method outlined in (A.O.A.C.)

1990.Total hydrozable carbohydrate were determined using the phenol sulphouric acid method as described by Dubois *et al*., (1956).

Biological evaluation:

Adult male albino rats (30 animals) weighed (140±5gm) were kept under normal healthy laboratory condition .The experimental animal fed on a normal diet consist of animal protein 20% as casein, corn oil (10%) cellulose 5%, salt mixture 4% (Hegsted *et al*, 1941) vitamin mixture 1% (Campbell, 1961) and corn starch 60%.(Table1). Diet and water were provided and lebtum .The animals were randomly divided into six groups .The first group (5rats) was fed on normal diet and severed as control group (G_1) .The other rats (25 rats) were injected with streptozotoain (15mg/kg body weight) to induce hyperglycemia according to Lazarow and Palay (1954). Then diabetic rats were dividing randomly into five groups (n=5) according to the experimental diet as follows group$_2$ (G_2): fed on basal diet till the end of experiment (hyperglycemic control).

Group3 (G_3): fed on chickpea as a raw material.

Group4 (G_4): fed on germinated chickpea.

Group5 (G_5): fed on soaked chickpea.

Group6 (G_6): fed on cooked chickpea

Table (1): The hypoglycemic diet constituents:

Diet constituent	Casein %	Chickpea gm	Oil %	Cellulose %	Starch %	Salt mix. %	Vit. mix. %
Normal control (basal diet) G_1	20	---	10	5	60	4	1
Hyperglycemic control G_2	20	---	10	5	60	4	1
Unprocessed chickpea(raw) G_3	---	77.77	3.88	4	131.15	4	1
Germinated chickpea G_4	---	72.30	4.36	---	18.34	4	1
Soaked chickpea G_5	---	74.72	5.75	---	15.01	4	1
Cooked chickpea G_6	---	70.25	5.33	---	19.25	4	1

Chemical assays:

1- Glucose in plasma was determined using the method described by Trinder (1969).
2- Total cholesterol was determined by enzymatic method describe by Fasce (1982).

Statistical analysis:

The obtained data were statistically analyzed according to methods described by Kurtz (1983).

RESULTS AND DISCUSSION

Table (2) shows the chemical composition of chickpea seeds as effected by processing treatments i.e., germination, soaking and cooking .The chemical composition of unprocessed seed (raw) amounted in 8.69, 21.85, 6.13, 4.73,3.84 and 53.88% for moisture, protein, total lipid, fiber, ash, and total hydrolyzable carbohydrates, respectively .The obtained results were in line with those of Sarantinos (1996), who found that moisture, ash , fat , fiber and total carbohydrates in ratios chickpea were 9.1, 24.0, 3.9, 5.7 and 52 % respectively
respectively .From the same table, it could be noticed that all chemical composition significantly affected as a result of processing methods. For instance, ash content increased significantly due to germination and soaking, meanwhile, cooking showed significant reduction. Protein and fiber increased significantly, while total lipids and carbohydrate decreased significantly due to all processing methods . The date were in agreement of those of Jood *et al* ., (1986) , who determined the chemical composition of processed chickpea and found that the germination decreased in the starch content and increased soluble sugars due to starch hydrolyzation to oligosaccharides during germination. This variation in the chemical composition due to the different processing methods may be attributed to the loss of some components in either soaking or cooking water.

The results of body weight, food intake and food efficiency of normal control and hyperglycemic rats,at the experimental period (8 weeks) are reported in table (3). It could be noticed that the gain in body weight of rats fed raw , germinated soaked or cooked chickpea showed significant increases compared to normal control , while

hyperglycemic rats showed non significant difference compared to normal control fed basal diet .The body weight gain can be arrange in the following ascending order : raw (91.5) < germinated (116:50) < soaked (125.25)< cooked (140.25). Concerning food intake, the values for normal control were 726.25gm and 673.00 gm for hyperglycemic control. While rats fed, raw, germinated, soaked or cooked chickpea consumed 935.75, 1045.0,1200and 1847.5 gm respectively .The statical analysis of food intake of the experimental animals on previously processed chickpea showed higher significant difference compared to normal control .The calculated data of food efficiency ratio (FER) for normal rats, hyperglycemic diet were 0.056 and 0.006gm/gm respectively.

On the other hand FER values of rats fed on G_3, G_4, G_5, G_6, chickpea were 0.097, 0.111, 0.103 and 0.112 gm/gm respectively, which showed non significant difference between G_4, G_5 andG_6. While it showed a significant increase between them and G3.On other hand, normal control and hyperglycemic control resulted in highly significant decrease compared to other treatments .The obtained results are in agreement with those reported by Morita *et al* (1997) who found that rats fed on chickpea growth, food intake and body weight gain showed higher than those fed on basal diet.

Data in table (4) shows the effect of normal and different treatments of chickpea feeding on organs weight and their ratio to body weight (b.w) of hyperglycemic rats.The obtained data revealed that, the liver weight of all treatments incaused the liver weight to increase in accordance with the increase body weight .The ratio between liver weight and body weight resulted in non significant difference except that of hyperglycemic control, which showed highly significant increase compared to other treatments. Similar results were found concerning kidneys as that of liver relative ratio.

The ratio between brain weight and body weight were shown in the same table .The results showed a significant increase due to hyperglycemic with normal control. Meanwhile diet containing processed chickpea showed significant decrease in ratio between brain and body weight. The obtained results were also confirmed by the data of Abdel Rahim *et al* (1988). Who found that organs /body weight ratios changed, and some ratios increased, but others decreased relative to control. Results

in table (5) shows the effect of processed chickpea on blood glucose levels of normal and hyperglycemic rats. The results showed that the serum glucose level was raised from 104.7 to 213 mg /dl after inducing hyperglycemia and reached the maximum value at the end of experimental period, where it reached 250 mg /dl in the hyperglycemic control. Glucose levels of the experimental animals which feeding raw, germinated, soaked and cooked chickpea were 216.0, 214.8, 215.40 and 212 .8 mg/dl at zero time. After two weeks of feeding processed chickpea a significant reduction ranged between 121and 105.4% of serum glucose was observed, relative to normal control. A continuous decrease in serum glucose was found which reached 121, 127.5, 121, 127.5 mg/dl after 4 weeks and about 105,95,100,99 mg/dl after 6 weeks for G_3, G_4,G_5,G_6 respectively. After the end of the experimental period, there were a slight decrease in serum glucose compared to that of 6 weeks for the same pervious groups .These results agreem with those of Panlasigui et al (1995) who found that the blood sugar response to all legumes was significantly lower compared to bread. The glycemic index of Chickpea was lower than those of black bean, pigeon pea and mung beans. Dilawari et al (1987) found a more significant decrease in blood glucose concentration when carbohydrate was given in form of legumes (rajmah, green gram and channa) than cereal or glucose . Results in table (6) show blood cholesterol level of hyperglycemic animals due to feeding processed chickpea. The results show that the total cholesterol level was raised from 63 to 83mg/dL after inducing hyperglycemia and reached the maximum value at the end in the experimental period, while it reached 98mg/dL in hyperglycemic control. Total cholesterol levels of animals fed on raw, germinate, soaked and cooked chickpea were 86, 87, 88and 86mg/dL at zero time. A continuous decrease in total cholesterol levels were found by about 79, 80, 85and 79mg/dL after two weeks and about 75, 74and 77mg/dL after four weeks, and about 73, 71, 73and76 mg/dL after six weeks for G_3, G_4, G_5 and G_6 respectively. After the end of the experimental period (8 weeks) there was a slight decrease compared to six weeks experimental period for the same pervious groups. It also revealed that all processed chickpea decreased cholesterol level of the diabetic rats. The cooked chickpea resulted in superior as functional food for reducing cholesterol followed by soaked and germinated chickpea.The obtained results were in good agreement with that obtained by Gabr (1998), who found that the hyperglycemia caused significant increase in total lipid, cholesterol, free fatty acids and triglyceride content relative to normal control. From the above mentioned data, processed chickpea such as soaking, germinated and cooking corrected the metabolic disturbance of diabetic patients.

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Table (2): The chemical composition of chickpea seeds (before and after processing) *

Treatment	Moisture %	Ash %	Protein %	Fiber %	Total lipid %	T.H.C** %
Unprocessed chickpea(raw)	8.69	3.84	21.85	4.74	6.13	53.88
Germinated chickpea	12.37	3.86	23.72	5.73	5.72	36.25
Soaked chickpea	6.36	3.44	23.61	5.70	4.44	52.0
Cooked chickpea	8.08	2.68	24.73	6.05	4.82	45.00
L.S.D. at 5%	0.05191	0.0367	0.03671	0.1038	0.07643	0.05191

* On dry weight basis.
**Total hydrolyzable carbohydrate.

Table (3): Effect of processed chickpea on body weight, food intake and food efficiency of hyperglycemic rats.

Treatments	Initial weight	Final weight	Body weight gain		Food intake	Food efficiency
	gm	gm	gm	%	gm	
Normal control (G_1)	133.75	175.25	41.50	31.03	726.25	0.056
Hyperglycemic control (G_2)	151.25	155.25	4.00	2.64	673.00	0.006
Unprocessed chickpea (G_3)	145.00	236.50	91.50	63.10	935.75	0.097
Germinated chickpea (G_4)	141.25	257.57	116.50	82.48	1045.00	0.111
Soaked chickpea (G_5)	150.00	275.25	125.25	83.50	1200.00	0.103
Cooked chickpea (G_6)	141.25	281.50	140.25	99.29	1847.50	0.076
L.S.D.at 5%	N.S	39.86	40.15	---	165.5	0.02190

Table (4): Effect of processed chickpea on organs weight and their ratio to body weight of normal and hyperglycemic rats.

Treatments	Final body weight	Liver		Kidneys		Brain	
	mg	mg	%	mg	%	mg	%
Normal control (G_1)	175.25	6.64	3.79	1.71	0.976	1.44	0.822
Hyperglycemic control (G_2)	155.25	8.13	5.24	2.06	1.33	1.50	0.967
Unprocessed chickpea (G_3)	236.50	7.46	3.15	2.00	0.847	1.49	0.63
Germinated chickpea(G_4)	257.75	8.96	3.48	2.16	0.839	1.49	0.578
Soaked chickpea(G_5)	275.25	9.82	3.57	2.42	0.880	1.63	0.540
Cooked chickpea (G_6)	281.50	9.53	3.93	2.57	0.912	1.36	0.484
L.S.D.at 5%	39.86	1.849	0.7015	0.5065	1.013	0.1647	0.1208

Table (5): Effect of processed chickpea on blood glucose levels of normal and hyperglycemic rats.

Treatment	Feeding period (week)																	
	Zero time		1st		2nd		3rd		4th		5th		6th		7th		8th	
	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%
Normal control (G1)	104.70	100.0	107.0	100	124	100	120	100	103	100	107	100	100	100	103	100	103.00	100
Hyperglycemic control (G2)	213.00	203.4	211	196.6	239	129.7	210	155	243	236	240	224.3	243	243	243	236	250	242
Unprocessed chickpea (G3)	216.0	206.34	150	139.3	132	106.5	142	118	121	117.5	113.2	105.79	105	105	102	99.03	100	97.0
Germinated chickpea (G4)	214.8	205.16	137.95	128.2	150	121	137.95	115	127.5	125	100	97.46	95	95	90	87.38	88.00	85.4
Soaked chickpea (G5)	215.40	205.73	149.95	139.7	130.7	105.4	124	103	121	117.5	97.0	90.65	100	100	95.0	92.7	93.0	90.3
Cooked chickpea (G6)	212.8	208.97	138.2	128.7	139	112	140	116.7	127.5	125	123.7	116.11	99	99	95	92.23	95	92.2
L.S.D. at 5%	3.55	---	14.10	---	6.363	---	6.078	---	11.25	---	11.59	---	8.93	---	8.735	---	8.043	---

Tabel (6): Effect of processed chickpea on total cholesterol levels of normal control and hyperglycemic rats.

Treatment	Feeding period (week)																	
	Zero time		1st		2nd		3rd		4th		5th		6th		7th		8th	
	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%	mg/dL	%
Normal control (G_1)	63.00	100	65.00	100	67.0	100	68.00	100	68.00	100	70.00	100	70.50	100	71.00	100	71.5	100
Hyperglycemic control (G_2)	83.00	131.75	83.00	127.69	86.00	128.36	86.00	126.47	90.00	132.35	91	130	95.01	34.75	96.0	135.21	98.0	137
Unprocessed chickpea (G_3)	86.00	136.51	86.00	132.3	79.00	117.91	77.0	113.24	75.00	110.29	75.00	107.14	73.00	103.55	70.50	99.3	70.0	97.90
Germinated chickpea (G_4)	87.00	138.10	85.00	130.77	80.0	119.4	76.00	111.76	74.00	108.82	73.00	104.29	71.00	100.7	70.00	98.59	70.0	97.90
Soaked chickpea (G_5)	88.00	139.92	86.00	132.31	85.0	126.87	80.00	117.65	77.0	113.24	78.0	111.43	73.00	103.35	73.5	103.32	72.00	100.7
Cooked chickpea (G_6)	86.00	136.51	85.00	130.77	79.00	117.91	77.5	113.97	77.0	113.24	76.5	109.29	76.00	107.8	77.7	109.4	76.0	106.20
L.S.D. at 5%	3.232	---	7.091	---	3.821	---	4.042	---	4.252	---	7.259	---	4.353	---	6.07	---	3.744	---

اثر العمليات التصنيعيه للحمص على مستوى السكر و الكولسترول فى سيرم حيوانات التجارب

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يعتبر الحمص من البقوليات الهامه و يرجع ذلك لارتفاع محتواه من البروتين. و في هذه الدراسه استخدم صنف جيزه(٢) و أجريت له عمليات تصنيعيه مختلفه مثل الإنبات- النقع- الطهي.ثم تم تقدير التركيب الكيمائي للحبوب بعد هذه المعاملات. بعد ذلك تم إجراء تجربه بيولوجيه على هذه المعاملات حيث تم اصابه مجموعه من الفئران بسكر الدم عن طريق حقنها بمادة استربتوزينوزين (١٥ ملجم/ كجم من وزن الجسم) ، ثم تغذيتها بمطحون الحمص المعامل بالمعاملات السابق ذكرها. و لقد أوضحت النتائج زيادة وزن الفئران عند التغذيه على الحمص المعامل بالإنبات و النقع و الطهي فكانت ٨٤،٤٨ - ٨٣،٥ -٩٩،٢٩ ٪على التوالي مقارنة بالكنترول الغير مصاب ، في حين كان الكنترول المصاب وزن٢٪,٦٤ مقارنة بالكنترول الغير مصاب. بالنسبه لوزن الأعضاء أوضحت النتائج وجود انخفاض معنوي في نسبة وزن الكبد و الكليتين و المخ إلي الوزن الكلى في كل المجاميع عدا المجموعه المصابه بالسكر حيث أظهرت زياده معنويه مقارنة بالكنترول. كذلك أظهرت النتائج أن تغذية حيوانات التجارب على الحمص و معاملاته تؤدى إلى تقليل مستوى السكر و الكولسترول في سيرم الدم.