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EVALUATION OF TRADITIONAL AND UNTRADITIONAL PROTEIN SOURCES IN RABBIT DIETS

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SUMMARY

Fourteen traditional and untraditional sources of protein included cotton seed meal, gluten meal, molasses yeast, soybean meal-48%, linseed meal, corn steep liquor, barley radicle, cassava leaves, corn germ meal, sunflower seed meal, full-fat rapeseeds, sesame seed residue, pea pods and olive pulp with pit were used as a partial substitute for protein of soybean meal-44% (control) in rabbit diets. The substitution level varied from 5% to 75% according to the protein content of each source.

One hundred and twenty New Zealand White rabbits, 5 weeks old and 685 gm average weight, were used to evaluate the experimental diets (15 diets) which were formulated to be iso-nitrogenous and isocaloric. Nutrient digestibilities of diets were 68.0-71.8%, 67.0-74.9%, 66.2-73.2%, 30.0-39.1%, 76.3-83.% and 74.-8-80.8% for DM, OM, CP, CF, EE and NFE, respectively. Most of the experimental diets had nearly the same or more TDN values than that of the control diet, except diets of soybean meal-48% and barley radicle in which they showed lower values. The average daily feed intake, body weight gain and feed conversion for all diets varied markedly being 23.7-33.9 gm, 78.9-99.8 gm and 2.62-3.42 gm feed/gm gain, respectively. Carcass and dressing percentages ranged from 48.5 to 55.8% and from 54.3 to 60.5%, respectively. Feed cost per 1 kg gain was lower by using diets contained cotton seed meal, molasses yeast, linseed meal and sesame seed residue than that of control diet.

Keywords: Rabbit, protein source, growth performance, dressing percentages

INTRODUCTION

Feed is the largest single item in the cost of animal production, representing at least 65%. More and more concern is given to minimize feed costs especially in large production units. Protein is the most important component of diets which commonly depends largely on the traditional sources of protein as soybean and cotton seed meals. According to With the shortage and consequently high cost of these protein sources and the possibility of using agro-industrial by-products in animal diets, so it is preferable to use these by-products as untraditional sources of protein to solve feed shortage problems and produce least cost diets.

The study reported herein was designed to investigate the effects of using traditional or untraditional protein sources in diets of rabbits on nutritional evaluation, animal performance and economic efficiency.

MATERIALS AND METHODS

Experimental protein source ingredients

Fourteen sources of protein included: cotton seed meal, gluten meal, molasses yeast, soybean meal-48%, linseed meal, corn steep liquor, barley radicle, cassava leaves, corn germ meal, sunflower seed meal, full-fat rapeseed, sesame seed residue, pea pods and olive pulp with pit were used as a partial substitute of soybean meal-44% (control) protein in rabbit diets. The substitution varied from 5 to 75% according to the protein content of each source. All diet ingredients were chemically analyzed as shown in Table (1).

Table 1. Proximate analysis of ingredient used in the experimental diets.

Ingredient	DM	OM	CP	EE	CF	NFE
Yellow corn	88.71	87.38	8.80	3.96	2.00	72.62
Barley	88.91	86.45	9.50	1.24	6.12	69.59
Clover hay	88.88	77.78	12.50	1.60	26.49	37.11
Wheat bran	88.90	83.53	14.00	4.00	11.20	54.33
soybean meal 44%, contrl	89.71	83.71	44.00	2.00	6.25	31.46
Molasses cane	74.00	88.87	4.20	-	-	84.67
Cotton seed meal	90.75	83.37	40.00	2.73	10.98	29.66
Gulten meal	90.59	87.46	52.00	1.70	2.30	31.46
Molasses yeast	91.64	84.41	40.00	2.00	2.00	40.30
Soybean meal 48%	89.84	83.99	47.00	1.97	3.86	31.16
Linseed meal	92.03	84.11	28.50	9.74	10.00	35.87
Corn steep liquor	89.13	86.39	27.00	1.45	4.41	53.53
Barley radicle	90.11	83.08	22.00	1.79	15.50	43.79
Cassava leaves	91.68	71.35	23.00	6.93	16.62	24.80
Corn germ meal	91.59	88.05	20.00	16.71	10.50	40.87
Sunflower seed meal	92.42	84.52	25.00	14.80	24.09	20.63
Full-fat rapeseeds	93.71	89.87	23.00	39.54	15.46	11.87
Sesame seed residue	94.44	86.47	21.00	39.51	10.22	15.74
Pea pods	89.61	84.32	16.50	0.98	25.98	40.86
Olive pulp with pit	91.99	88.36	5.80	13.37	36.97	32.22

Experimental diets

Fifteen pelleted experimental diets were formulated to be iso-nitrogenous, iso-caloric and approximately similar in their chemical composition (Tables 2 and 3). Digestible energy (DE) values of diets were calculated according to Fekete and Gippert (1986). DE (Kcal/kg) = 4253-32.6 (CF%)- 144.4 (ash %).

Feeding trial

One hundred and twenty, New Zealand White weaned unsexed rabbits of 5 weeks old and 685 gm average body weight were randomly distributed into fifteen groups of eight animals each, to study effects of the experimental diets on rabbits performance. Animals were housed in separate cages and fed individually.

At the end of feeding trial which lasted for 6 wks, six rabbits of each treatment were fasted for 16 hrs, weighed (pre-slaughter weight) and slaughtered to:a) evaluate carcass characteristics as described by Fennell *et al.*, 1990), determine blood constituents such as total protein (Gornall *et al.*, 1949) total lipids (Zollner and Krisch, 1962); cholesterol (Siedel *et al.*, 1983) and GOT and GPT (Reitman and Frankel, 1957).

Table 2. Composition of the experimental diets*

Diets of	Protein source	Corn	Barley	Hay	Soy. meal	Wheat bran	Lys**	Meth**
Soybeen meal-44%,Control	-	2.00	15.00	27.50	13.00	38.00	-	0.200
Cotton seedmeal	10.73	2.02	15.41	23.00	3.25	41.00	0.110	0.180
Gluten meal	8.25	3.94	15.00	30.00	3.25	35.00	0.190	0.070
Molasses yeast	10.73	4.00	12.00	29.05	3.25	36.50	-	0.170
Soybean meal - 48%	9.13	2.00	15.00	28.13	3.25	38.00	-	0.190
Linseed meal	10.04	2.00	9.00	24.00	6.50	43.96	0.069	0.131
Corn steep liquor	10.60	1.21	7.00	25.50	6.50	44.40	0.200	0.290
Barley radicle	6.50	2.06	9.90	23.00	9.75	44.25	0.036	0.204
Cassava Leaves	6.22	5.90	7.50	22.51	9.75	43.63	-	0.190
Corn germ meal	7.15	3.63	5.50	24.00	9.75	45.50	0.016	0.154
Sunflower seed meal	5.72	2.03	11.00	19.53	9.75	47.50	-	0.170
Full-fat - Rapeseeds	3.74	1.33	9.80	25.50	11.05	44.00	0.057	0.223
Sesame seed residue	4.10	3.41	6.00	24.91	11.05	45.94	0.057	0.223
Pea pods	5.22	2.96	9.50	18.69	11.05	48.00	0.068	0.212
Olive pulp with pit	4.90	11.70	0.50	17.00	12.36	49.00	0.050	0.190

* Each diet contained 2.20 % molasses; 1.50% limestone; 0.3% premix and 0.3% salt.

**Lysine and methionine were added to all the experimental diets at the rate to be similar in their contents.

Digestion trial

Fourty five male New Zealand White rabbits, three months old at least and had similar body weights, were used in fifteen digestion trials (7 days as a preliminary period followed by another 7 days as a collection one). The experimental diets were offered ad. lib. twice daily (9 a.m. and 3 p.m.). Samples of feces were dried (60^{o}C for 2 days) then analyzed as described by A.O.A.C. (1980).

Statistical analysis

Data were statistically analyzed by the computer program of SAS (1987), using the General Linear Models (GLM) procedure. Statistical significance for the main effects was declared at P<0.05 by using Duncan's New Multiple RangeTest (1955).

RESULTS AND DISCUSSION

Nutritional evaluation

The proximate analysis and the nutritional value of the different experimental ingredients and diets are presented in Tables 1,2 and 3. The experimental diets contained DM, CP, CF, EE, NFE and DE which ranged from 90.13 to 90.88%; 15.71 to 16.47%; 12.65 to 13.87%; 2.32 to 4.85%; 48.27 to 51.24% and 2559 to 2816 Kcal/kg, respectively (Table 3). All diets supplied the nutrient requirements according to feeding standards for growing rabbits (Cheeke, 1987). However, the dietary digestible energy levels were somewhat higher than the level of 2500 Kcal/kg recommended by NRC, 1977.

Table 3. Proximate analysis (%)and digestable energy content (Kcal/kg) of the experimental diets.

Diets of	DM	OM	CP	EE	CF	NFE	DE
Soybean meal-44% (Control)	90.18	82.08	16.18	2.96	13.40	49.54	2647
Cotton seed meal	90.55	82.69	15.98	2.32	13.15	51.24	2690
Gluten meal	90.87	82.77	16.47	2.60	13.16	50.54	2655
Molasses yeast	90.13	81.53	16.06	2.67	13.87	48.93	2559
Soybean meal - 48%	90.35	82.11	16.38	2.66	13.50	49.57	2623
Linseed meal	90.49	82.31	16.27	3.18	13.14	47.72	2644
Corn steep liquor	90.42	82.72	16.32	2.88	13.19	50.33	2711
Barley radicle	90.38	82.34	16.27	2.90	13.22	49.95	2662
Cassava leaves	90.88	82.86	15.71	3.10	13.13	50.83	2667
Corn germ meal	90.27	82.64	15.75	3.95	12.65	50.29	2739
Sunflower seed meal	90.57	82.47	16.19	3.41	13.04	49.83	2658
Full - fat rapeseeds	90.47	82.55	16.18	4.48	13.52	48.27	2672
Sesame seed residue	90.33	83.00	16.19	4.32	13.17	49.32	2765
Pea pods	90.77	82.41	16.29	2.88	13.33	49.91	2611
Olive pulp with pit	90.42	83.51	15.29	4.17	13.48	49.88	2816

Nutrient digestibilities data (Table 4) indicated that the differences in DM and OM among the most diets were insignificant, except for corn steep liquor (OM) and barley radicle (DM) which showed lower values. Moreover, most diets had no significant difference in CP digestibilities, except the diets containing corn steep liquor, barley radicle or corn germ meal in which they had a lower values than the other experimental diets. The technological processing of corn and barley might be responsible of structural alterations of proteins which lead to changes of their biological values and become more resistance to the action of proteolytic enzymes (Peer and Leeson, 1985 and Darman and Isarova, 1989).

Digestibilities of CF varied markedly, ranging from 30.0% of barley radicle diet to 39.1% of sunflower seed meal diet. This fidning is similar to that obtained by Fekete and Gippert (1986) where they reported that rabbits utilize fiber rather poorly (20-40%). Diets of gluten meal, barley radicle, full-fat rapeseed and olive pulp with pit resulted in lower values of CF digestibility.

Significant differences in the digestibility coefficients of EE among the different diets (ranged from 76.3 to 83.6%) were observed. Digestibilities of NFE ranged from 74.8 to 84.3%. Diets of cotton seed meal, molasses yeast, linseed meal, corn steep liquor, cassava leaves, corn germ meal, full-fat rapeseed meal and sesame seed residue had slightly higher values of NFE digestion than those of the other diets.

The nutritive values as TDN of all diets (Table 4) differed in narrow limits, ranging from 58.9 to 63.6%. This might be due to the similarity of the diets in their composition and in most of nutrients digestibility. The linseed diet had the highest DCP value, while it was lowest in corn germ meal diet, being 12.80 and 11.20%, respectively. The control diet did not differ significantly when compared with the other diets, except diets of corn steep liquor, barley radicle cassava leaves and corn germ meal which showed lower DCP values.

Table 4. Nutrients digestibility and nutritive value of the experimental dits.

Diets of	Digestion coefficients						Nutritive value	
	DM	OM	CP	EE	CF	NFE	TDN	DCP
Soybean meal - 44% (Control)	69.8a	70.6bc	73.2a	83.6a	37.9ab	77.7b	61.4b	12.7a
Cotton seedmeal	70.7a	71.2b	72.9a	83.5a	37.1ab	79.0a	62.0b	12.5a
Gluten meal	70.5a	70.2bc	68.7bc	76.3c	33.9d	80.7a	61.4b	12.2ab
Molasses yeast	71.7a	71.7b	72.0ab	80.6b	38.0a	80.5a	61.5b	12.4a
Soybean meal - 48%	68.0b	68.2c	71.7ab	79.7b	37.5ab	74.8	58.9c	12.6a
Linseed meal	71.8a	72.6ab	73.2a	81.6ab	38.2a	80.8a	63.3a	12.8a
Corn steep liquor	71.4a	74.9a	67.0cd	77.9c	36.3bc	84.3	63.6a	11.7bc
Barley radicle	67.0b	67.6c	68.0bc	78.8b	30.0e	77.0c	59.0c	11.9bc
Cassava Leaves	70.6a	71.7b	69.6b	79.0b	38.2a	80.7d	61.3b	11.8bc
Corn germ meal	70.5a	71.3b	66.2d	77.8c	37.5ab	80.2a	62.8a	11.2c
Sunflower seed meal	69.1ab	70.4bc	69.6b	80.7b	39.1a	77.9bc	61.7b	12.1ab
Full-fat - Rapeseeds	69.2ab	69.7bc	69.1bc	81.0b	31.5e	79.5a	63.3a	12.0ab
Sesame seed residue	70.4a	71.9b	71.2ab	81.0b	35.0cd	80.6a	63.6a	12.4a
Pea pods	69.ab	70.0bc	68.7bc	82.3a	37.9ab	78.2bc	61.0b	12.0ab
Olive pulp with pit	69.1ab	69.8bc	71.3ab	83.5a	30.2e	78.6bc	62.9a	12.3a

Means bearing common superscripts in the same column are not significantly different (P>0.05).

Rabbit performance

The daily feed intake (Table 5) ranged from 78.90 to 99.89 gm. It was higher of cassava leaves diet and lower of cotton seed meal, gluten meal, corn steep liquor, barley radicle, corn germ meal and sesame seed residue diets than that of the control diet (soybean meal 44% CP).

No significant difference was observed in daily body gain between rabbits fed the control diet and those fed diets of cotton seed meal, molasses yeast , olive pulp with pit and linseed meal. The other groups had lower daily body gains especially those fed of corn germ meal and corn steep liquor.

The feed conversion values (kg feed/kg gain) ranged from 2.62 to 3.42. It was high of diets contained soybean meal-44% (control), cotton seed meal, glumeal, molasses yeast, linseed meal and sesame seed residue, while they were low of other diets. Results reported in the present study confirmed those reported by Johnson and Berrio, (1985); Grandi *et al.*, (1986)and Raya *et al.*, (1991).

Carcass characteristics

Carcass and dressing percentages (Table 6) of rabbits fed diets of corn steep liquor, barley radicle and corn germ meal were lower than those fed the other diets which showed insignificant differences among them.

Table 5. Performace of the experimental rabbits.

Animals fed the diet of	Body weight (g)			Daily feed intake (g)	Feed conversion (g feed/ g gain)
	Initial	Final	Daily gain		
Soybean meal - 44%					
Control	685a	2110a	33.9a	93.4a	2.75c
Cotton seed meal	681ab	2093a	33.6a	88.1b	2.62c
Gluten meal	682ab	1920bc	29.5b	83.9c	2.84bc
Molasses yeast	692a	2097a	33.5a	94.6a	2.83bc
Soybean meal 48%	685ab	1968b	30.6ab	95.1a	3.11ab
Linseed meal	685ab	2107a	33.9a	91.7ab	2.71c
Corn steep liquor	686ab	1732d	24.9c	78.9c	3.17a
Barley leaves	697a	1840cd	27.2bc	88.4b	3.25a
linseed meal	672bc	1905bc	29.4b	99.89	3.40a
Corn germ meal	675bc	1671d	23.7c	81.0c	3.42a
Sunflower seed meal	700a	1987b	30.6b	95.5a	3.12ab
Full-fat rapeseeds	686ab	1928bc	29.6b	93.3a	3.15ab
Sesame seed residue	686ab	1936bc	29.8b	84.1c	2.82bc
Pea pods	682ab	1916bc	29.4b	94.8a	3.22a
Olive pulp with pit	684ab	2035ab	32.2a	94.4a	2.93b

Means bearing common superscripts in the same column are not significantly different (P>0.05).

Blood constituents

Primarily, the data in Table 6 were in the normal range recorded for rabbits by Favarato and Zatta, (1990). Total plasma protein concentration was lower in rabbits fed diets of corn steep liquor, barley radicle and corn germ meal than that of others. This might be due to the lower digestibility of CP of these ingredients. These results are in agreement with Hussein, (1991), who reported insignificant differences among chicks fed soybean meal, cotton seed meal, sesame meal, linseed meal, gluten meal and molasses yeast in plasma total protein contents. Values of glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) had the same trend detected of plasma total protein. Grassman *et al.* (1981) found that protein in blood might be related with GOT. Rabbits fed full-fat rapeseed, olive pulp with pit and corn steep liquor diets resulted in the lowest concentration of total lipids. No significant difference in blood cholesterol level was observed among the groups fed the control, molasses yeast, soybean meal-48% and linseed meal diets. While, it was lowest in diets of gluten meal, corn steep liquor, barley radicle and sunflower seed meal.

Table 6. The carcass characteristics and some blood constituents of rabbits fed the experimental diets.

Animal fed the diet of	Carcass %	Dressing %	Blood constituents				
			Total Prot. (mg/dl)	GOT (U/dL)	GPT (U/dL)	Total Lipid (g/dL)	Choles-terol (mg/dl)
Soybean meal - 44%	55.8a	60.3a	6.97a	43.69a	30.67ab	0.295bc	84.16a
Cotton seed meal	55.8a	60.5a	6.97a	40.02a	32.45a	0.297bc	74.20b
Gluten meal	55.4a	60.2a	6.67ab	40.55a	30.62b	0.323ab	52.91e
Molasses yeast	55.0a	59.7a	6.81ab	42.78a	31.08ab	0.352a	92.44
Soybean meal 48%	55.3a	59.8a	6.67ab	41.39a	31.00ab	0.310b	83.94a
Linseed meal	54.5a	59.8a	6.72ab	41.09a	30.38b	0.307bc	79.17a
Corn steep liquor	50.4b	54.5b	5.82c	29.48	28.45c	0.207	49.40e
Barley leaves	50.2b	54.6b	5.84c	33.76b	28.12c	0.300bc	47.07e
linseed meal	55.2a	59.2a	6.69ab	42.34a	31.49ab	0.315b	67.13cd
Corn germ meal	48.5b	54.3b	5.91c	33.27b	27.80c	0.340a	70.35bc
Sunflower seed meal	55.0a	59.5a	6.69ab	40.64a	30.57b	0.308bc	67.52cd
Full-fat rapeseeds	54.9a	59.4a	6.64ab	42.14a	30.34b	0.260d	65.54d
Sesame seed residue	55.0a	59.9a	6.68ab	43.76a	30.16b	0.322ab	63.82d
Pea pods	55.1a	59.7a	6.69ab	43.04a	30.26b	0.327ab	64.51d
Olive pulp with pit	54.7a	59.6a	6.70ab	43.25a	31.62ab	0.248d	75.99b

Means bearing common superscripts in the same column are not significanlty different (P>0.05).

Economic efficiency

Feed cost per kg diet of the control diet was higher than that of most diets, except diets of gluten meal, soybean meal-48% and full-fat rapeseed (Table 7). Moreover, diets of linseed meal, cotton seed meal, molasses yeast and sesame seed residue exhibited the best economic efficiency values, while the poorest values were found with diets of soybean meal-48% and full-fat rapeseed.

The present results indicated that there are several alternative sources of protein, either traditional or untraditional sources that could be successfully used in formulating diets of rabbits.

Table 7. Economic evaluation of the experimental diets.

Animal fed the diet of	Price of * Kg diet	Feed intake (Kg/head)	Total feed cost	Body wt. gain (Kg/head)	Economic efficiency**
Soybean meal - 44%	41.3	3.92	161.9	1.425	113.6
Cotton seed meal	39.4	3.70	145.8	1.412	103.3
Gluten meal	41.4	3.52	145.8	1.239	117.7
Molasses yeast	38.9	3.97	145.5	1.405	103.6
Soybean meal 48%	43.6	3.99	174.2	1.283	135.8
Linseed meal	38.1	3.85	146.8	1.422	103.2
Corn steep liquor	36.9	3.31	122.3	1.046	116.9
Barley leaves	38.9	3.71	143.3	1.143	125.4
linseed meal	36.8	4.19	154.2	1.233	125.1
Corn germ meal	34.3	3.43	116.7	0.996	117.2
Sunflower seed meal	38.0	4.01	152.2	1.287	118.3
Full-fat rapeseeds	41.5	3.91	162.3	1.242	130.7
Sesame seed residue	38.9	3.53	137.3	1.250	109.8
Pea pods	38.4	3.98	152.7	1.234	123.7
Olive pulp with pit	39.2	3.95	155.0	1.351	114.7

* Ingredients price per ton at 1994 were : 510 yellow corn; 510 barley; 300 hay; 225 wheat bran; 990 soybean meal - 44%; 220 molasses; 40 limestone; 2100 premix; 100 salt; 12000 lysine; 13000 methionine; 970 conttonseed meal; 1100 gluten meal ; 750 molasses yeast; 1300 soybean meal - 48%; 600 linseed meal; 200 corn steep liquor; 400 barley radicle; 150 cassava leaves; 470 or corn germ meal; 455 sunflower seed meal ; 900 fullfat rapeseeds; 350 sesame seed residue; 150 pea pods and 250 olive pulp with it. **Economic efficiency = Feed cost per 1 Kg gain.

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تقييم مصادر البروتين التقليدية وغير التقليدية فى علائق الأرانب

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شملت الدراسة أربعة عشر مصدر بروتين تقليدى وغير تقليدى وهى كسب القطن وجلوتين الذرة وخميرة المولاس وكسب فول الصويا (٤٨٪) وكسب الكتان ومخلفات منقوع الذرة وراديسيل الشعير وأوراق الكسافا وكسب جنين الذرة، كسب عباد الشمس وبذور الشلجم كاملة الدهن وبذور والسمسم (الفرزة) وقشر البسلة المجفف وتفل الزيتون لتحل جزئياً محل بروتين فول الصويا (٤٤٪) فى علائق الأرانب . وقد تباينت نسب الإحلال من ٥٪ إلى ٧٥٪ تبعاً لمحتوى كل مصدر من البروتين. إستخدام ١٢٠ أرنب نيوزلاندى أبيض (عمر ٥ أسابيع ومتوسط وزن ٦٨٥مج) قسمت عشوائياً إلى ١٥ مجموعة لتقييم العلائق المختبرة (١٥ عليقة) والتى كانت متشابهة فى محتواها من الطاقة والبروتين.

تراوحت معاملات هضم العلائق بين ٦٨,٠ – ٧١,٠٪ ، ٦٧,٠ – ٧٤,٩٪ ، ٦٦,٢ – ٧٣,٢٪ ٣٠,٠ – ٣٩,٠٪ ، ٧٦,٣ – ٨٣,٦٪ ، ٧٤,٨ – ٨٠,٨٪ لكل من المادة الجافة والمادة العضوية والبروتين الخام والألياف الخام ومستخلص الأثير ومستخلص المواد الخالية من الأزوت على التوالى . وكان مجموع المركبات الغذائية المهضومة لغالبية العلائق يماثل أو يزيد عن عليقة المقارنة فيما عدا العلائق المحتوية على كسب فول الصويا (٤٨٪) وراديسيل الشعير والتى أظهرت قيما أقل.

تباينت بصورة ملحوظة متوسطات المأكول اليومى والزيادة فى الوزن والكفاءة التحويلية لجميع العلائق فكانت تتراوح بين ٢٣,٧ – ٣٣,٩ جم، ٧٨,٩ – ٩٩,٨ جم ، ٢,٦٢ – ٣,٤٢ جم غذاء لكل جم زيادة فى الوزن على التوالى وتراوحت نسب وزن الذبيحة والتصافى بين ٤٨,٥ – ٥٥,٨٪ ٥٤,٣ – ٦٠,٥٪ على التوالى وكانت تكلفة التغذية لكل ١ كجم زيادة فى الوزن منخفضة فى العلائق المحتوية على كسب القطن وخميرة المولاس وكسب الكتان وبذور السمسم (الفرزة) وذلك مقارنة بعليقة المقارنة.