Nigerian J. Anim. Sci. 2012, 14:188-196

Effect of Processing Methods on the Proximate and Energy Composition of *Lablab Purpureus* (Rongai) Beans

Abeke, F.O., Amodu, J.T., Ogundipe, S.O., Sekoni, A.A. and Adeyinka, I.A.
National Animal Production Research Institute Ahmadu Bello University, Zaria

Target audience: Poultry farmers, feed millers, researchers, extension agents

Abstract

Four methods of processing were assessed to investigate the effect of processing methods on the digestibility, proximate and energy composition of Lablab purpureus (Rongai) beans. The processing methods were boiling (in water), fermentation, toasting and fermentation plus toasting. Some of The beans were boiled for 0, 10, 20, 30, 40, 50 or 60 minutes and sundried for three days before proximate analysis. For the beans processed by fermentation, they were soaked in water for 0, 24, 48 and 72 hours respectively and sundried for three days before analysis. Samples were toasted for 0, 10, 20, 30, 40 and 50 minutes respectively using a frying pan over an open wood fire, with constant stirring to prevent charring. The last treatment involved the beans first being fermented for 0, 24, 48 and 72 hours, dried in the sun for three days, before being toasted for 10 minutes. The beans were then milled. A representative sample of the milled lablab beans from each of the processing method along with a raw sample of the beans were taken to the laboratory for proximate analysis. Estimates of gross, digestible and metabolizable energy values beans was done through standard mathematical formulae using the values of their proximate composition. Results obtained indicated significant differences in proximate and energy composition due to processing method.

Keywords: Processing, cooking, fermentation, toasting, lablab beans, energy, proximate.

Description of Problem

The need to provide information on unconventional feed ingredients that are presently being used in poultry feed formulation has become very imperative. One area where information is scarce is on how processing methods can affect the composition of some of these legumes beans. It is important to provide handy baseline information that one can use to determine inclusion levels of these beans in practical diets. *Lablab purpureus* beans has gain some recognition in recent times as a legume that can replace a certain amount of the conventional cakes like soya cake and groundnut cake in poultry diets (1, 2). There remain a lot of research work to be carried out on this novel beans to determine the effect of processing methods on their composition. The aim will be to ascertain the cheapest and best method that farmers can easily adopt to process the beans and make it safe for incorporation into diets especially for poultry and pigs. According to (1), the adoption of any of the processing methods is influenced by cost, location, environmental condition, choice and facilities available at the farmer's disposal. However, each of the processing methods has effect on the proximate and energy composition of this legume beans. The importance of digestible and metabolisable energy (DE and ME) in the nutrition of pigs and poultry cannot be over emphasized. This is because ME is the unit of energy utilization for birds. On the other hand digestible energy (DE) is used to calculate energy requirement for pigs, ME indicates the amount of energy actually utilized (metabolized) in the body of birds out of the total energy digested and absorbed from the gastro intestinal tract. Gross energy (GE) refers to the total energy a feed substance can release on combustion using the bomb calorimeter. Only a fraction of the GE is actually digested and metabolized by birds. The percent utilization of digestible energy or gross energy by birds depend on the quality of diets, health status of birds, age of birds, forms of diets etc. The determination of the digestible and metabolizable energy of feed or feed ingredients can be carried out either through experimental procedure or through the use of mathematical formulae using the values obtained from the proximate composition of the material (3). While the former is considered more reliable and may give a more accurate value, the values obtained from the latter is very useful and can be relied upon when facilities for proper experimentation are unavailable.

This study was conducted to investigate the effect of processing methods on the proximate and energy compositions of *Lablab purpureus* (Rongai) beans.

Materials and Method

The *Lablab purpureus* (Rongai) beans used for this study were obtained from the Forage and Crop Residue Research Programme Farm at the National Animal Production Research Institute, Shika Zaria. It is milky white in colour. The processing methods adopted are as follows: For the cooked lablab, the beans were processed by boiling in water. About 4 litres of water was first brought to boiling in a 10 litre domestic alluminium cooking pot and about 200g of the beans was poured into the boiling water and covered. Cooking was timed from the moment the beans were poured into the water.. Samples of the beans were cooked for 10, 20, 30, 40, 50 or 60 minutes and sundried for 3 days before milling. Processing by fermentation involved soaking 200g of the beans in a 10 litre plastic bucket containing 4 litres of clean water. The beans were not stirred, neither was the water changed for the duration of the fermentation. Samples of the beans were left to ferment for 24, 48 and 72 hours, respectively. They were then sundried for 3 days and then milled. The third group of samples were toasted. About 200g of the beans was first sprinkled with water before being place in a dry frying pan heated with fire wood. The beans were continuously stirred throughout the duration of the toasting to prevent charring. Samples were toasted for 10, 20, 30, 40 or 50 minutes respectively, allowed to cool and then milled. The last group of bean samples were first fermented for 24, 48 and 72 hours, then sundried for three days before being toasted for 10 minutes. A representative sample of the milled lablab beans from each of the processing method along with a raw sample of the beans were taken to the Laboratory for proximate analysis according to (4) procedure. The formulae of (5), stated below were used for calculating the GE, DE and ME values of the processed beans. Results obtained were analyzed using the (6) general linear model and differences were separated using Duncan Multiple Range Test (7).

Gross Energy (GE kcal/kg) = 240.33 [0.0226 (%CP x 10) + 0.0407 (%EE x 10) + 0.0192 (% CF x 10) + 0.0177(%NFE x 10)]

Digestible Energy (DE kcal/kg) = (5.5 x g dCP) + (9.5 x g dEE) + (4.2 x g dCF) + (4.2 x g dNFE)

Where d is digestibility coefficient: d for CP = 85%; d for EE = 85%; d for CF = 30% and d for NFE = 85%

Metabolizable Energy (ME kcal/kg) = 37(%CP) + 81.8(%EE) + 35.5 (%NFE) $\pm$ 100

Results and Discussion

Results of the proximate and their respective energy compositions of the lablab beans processed by cooking, fermentation, toasting and fermentation with toasting are presented in Tables 1a, 1b, 2a, 2b, 3a, 3b, 4a and 4b, respectively.

Results obtained for the cooking duration of lablab beans (Table 1a) shows that there was no significant (P>0.05) difference in proximate composition even though there was a trend towards a gradual decrease in crude protein, crude fibre, ether extract and ash as the duration of cooking increased. This loss in nutrient is probably due to leaching of nutrient into the boiling water. According to (1) and (8) there is nutrient loss when legume beans are boiled in water because of leaching of nutrient into the boiling water. Abeke (9) also observed nutrient loss when lablab beans were subjected to boiling in water for different time duration and reported that as the duration of boiling increased, there was a corresponding increase in nutrient loss. According to (10) there is nutrient loss when legume beans are processed either by boiling, toasting or by fermentation.

Results obtained on the effect of cooking duration on the gross energy, digestible and metabolizable energy values of *lablab purpureus* beans (Table 1b) showed that as the duration of cooking increased, there was a significant (P>0.05) decrease in GE, DE and ME values. The reason for this could be as a result of nutrient loss in the boiling water. According to (11) and (10) there is nutrient loss when legume seeds are boiled in water because of leaching of nutrient into the boiling water.

Table 1a: Effect of cooking duration on the proximate composition of *Lablab purpureus* (Rongai) beans.

Duration of cooking(Mins)	%Dry Matter	%Crude Protein	%Crude Fibre	%Ether extract	%Ash	%NFE
0	95.97	24.56	11.96	9.13	3.85	50.50
10	96.02	23.69	11.93	9.11	3.84	51.43
20	96.14	23.56	11.90	9.08	3.82	51.64
30	96.28	23.29	11.88	9.06	3.81	51.96
40	96.42	23.28	11.74	9.04	3.80	52.14
50	96.71	22.31	11.62	9.01	3.78	53.28
60	96.83	22.06	11.48	9.00	3.77	53.69
SEM	0.94	0.71	0.58	0.46	0.38	1.87

However, in practical diets, the difference of between 100 to 200 kcal/kg must be observed between diets before difference in performance can be attributed to energy. Though there was a gradual increase in the utilization of GE and DE for ME, as the cooking duration increased, which indicate that cooking improved energy release and availability, the difference was not statistically significant (P>0.05). According to (2) cooking generally improves nutrient utilization by reducing or eliminating anti nutrients in feed. Also starch is converted to more soluble maltose while fibre is gelatinized, making it more digestible.

Table 1b: Effect of cooking duration on the GE, DE and ME values of *Lablab purpureus* beans and their percent utilization

Duration of cooking(mins)	GE (kcal/kg)	DE (kcal/kg)	ME (kcal/kg)	%GE digested	%GE Met	%DE Met
0	4927^{a}	3842^{a}	3448^{a}	77.90	69.99	89.74
10	4915^{b}	3830^{b}	3448^{a}	77.92	70.15	90.03
20	4912^{b}	3831^{b}	3448^{a}	77.99	70.02	90.00
30	4909^{b}	3825^{bc}	3448^{a}	77.92	70.22	90.14
40	4907^{b}	3828^{b}	3452^{ab}	78.01	70.34	90.18
50	4896^{bc}	3793^{d}	3454^{b}	77.47	70.55	91.06
60	4892^{c}	3819^{c}	3458^{b}	78.07	70.70	90.55
SEM	5.54	2.12	1.92	0.58	0.43	0.85

$^{a, b, c}$, Means within columns with different superscripts are significantly (P<0.05) different. SEM standard error of the means. Met metabolized

Results obtained for the proximate composition for beans processed by fermentation (Table 2a) shows that there was a significant (P<0.05) difference in composition of the beans at different fermentation duration. Dry matter, protein, ether extract and ash decreased as the duration of fermentation increased. This shows that nutrient loss occurred through leaching into the water. Report by (2) and (10) indicates that nutrient loss is bound to occur under any processing method. However, the authors stated that fermentation is the simplest and cheapest method that farmers in rural areas can employ to process legume seeds for incorporation into animal diets. Although fermentation may impart bad odour and hence reduce palatability of feed, this can be overcomed by frequent changing of the water to prevent putrefaction.

Table 2a: Effect of fermentation on the proximate composition of *Lablab purpureus* (Rongai) beans.

Duration of fermentation (Hours)	%Dry Matter	%Crude Protein	%Crude Fibre	%Ether extract	%Ash	%NFE
0	95.97[a]	24.56[a]	11.96[a]	9.13a	3.85[a]	50.50[b]
24	91.57[b]	20.69[b]	7.56[b]	7.16[b]	2.31[b]	62.28[a]
48	91.50[b]	19.88[b]	8.26[b]	6.14[b]	1.41[c]	64.31[a]
72	87.90[c]	17.69[c]	8.48[b]	6.76[b]	3.43[ab]	63.64[a]
SEM	1.21	1.34	0.57	1.03	0.34	3.54

[a,b,c] Means within column with different superscripts are significantly (P<0.05) different. SEM standard error of the means.

Effect of fermentation on GE, DE and ME of lablab purpureus beans (Table 2b) showed that although there was a decrease (P>0.05) in GE as the duration of fermentation increased, the reverse was the case for the ME. While the GE and DE may have decreased as a result of nutrient loss in the fermentation water (12), ME values and their utilization were improved because of the positive influence of fermentation on nutrient availability and feed efficiency (10).

Results obtained for the toasted beans (Table 3a) showed significant (P>0.05) differences in crude protein, crude fibre, ether extract and nitrogen free extract. Dry matter and ash content did not show any significant (P>0.05) difference. Values obtained for crude protein, crude fibre and ether extract were significantly (P<0.05) better for the raw beans than those toasted. Reduction in values of the crude protein, crude fibre and ether extract for the toasted samples as compared to the raw sample could be due to volatilization or slight charring of these nutrients as a result of heat. Toasting may result in charring of the materials thereby reducing their nutrient level. Ether extract is very volatile in the presence of heat hence the reduction observed in the toasted beans.

Table 2b: Effect of fermentation on the GE, DE and ME values of *Lablab purpureus* beans and their percent utilization

Fermentation Duration (hrs)	GE (kcal/kg)	DE (kcal/kg)	ME (kcal/kg)	%GE Digested	%GE Met	%DE Met
0	4927[a]	3842[b]	3448[c]	77.98	69.99[c]	89.74
24	4822[b]	3864[a]	3562[a]	80.13	73.87[b]	92.18
48	4798[c]	3825[c]	3521[b]	79.72	73.39[b]	92.05
72	4577[d]	3752[d]	3467[c]	81.97	75.74[a]	92.40
SEM	10.26	5.20	11.78	3.11	1.15	1.42

[a,b,c] Means within columns with different superscripts are significantly ($P<0.05$) different. SEM standard error of the means. Met metabolized

Table 3a: Effect of Toasting duration on the proximate composition of *Lablab purpureus* (Rongai) beans

Duration of Toasting (Mins)	%Dry Matter	%Crude Protein	%Crude Fibre	%Ether extract	%Ash	%NFE
0	95.97	24.56[a]	11.96[a]	9.13[a]	3.85	50.50[c]
10	94.46	17.50[d]	7.87[c]	5.40[c]	3.72	62.51[b]
20	94.79	20.69[b]	7.82[c]	6.11[b]	3.73	61.65[b]
30	94.87	19.00[c]	9.17[b]	7.31[b]	3.34	61.18[b]
40	95.17	19.56[c]	8.13[bc]	4.94[c]	3.20	68.17a
50	95.56	21.50[b]	7.82[c]	5.83[c]	3.27	61.58[b]
SEM	0.76	1.01	1.02	1.12	1.11	3.40

a,b,c Means within column with different superscripts are significantly ($P<0.05$) different. SEM standard error of the means.

According to (10) sprinkling of water on legume seeds before being toasted may reduce the toasting time and hence nutrient loss because the steam generated will penetrate deeper into the beans for better cooking. There was a fluctuation in the values of GE and DE as toasting duration increased (Table 3b). The reason for this is not clear but may be due to difficulty in maintaining constant heat as a result of use of fire wood as a heat source. However, ME values did not follow any particular trend although 40 minutes of toasting gave the best ME value. Bawa *et al.* (1) and Abeke *et al.* (2) had earlier reported that *lablab* *purpureus* beans heated for a duration of about 40 minutes gave the best performance in pigs and poultry respectively. Percent utilization was also improved as the duration of toasting increased. This indicates that heat treatment improves nutrient availability and hence improves utilization.

For the beans that were fermented before being toasted, (Table 4a), results obtained indicate significant ($P<0.05$) differences among the means. The raw sample had significantly ($p<0.05$) higher crude protein, crude fibre, ether extract and ash contents than the others. The reason for this could be due to nutrient loss both from leaching during the fermentation process and during toasting. According to (2) there is bound to be nutrient loss under any processing method either through leaching, volatilization or through dust particles.

Table 3b: Effect of Toasting duration on the GE, DE and ME values of *Lablab purpureus* beans and their percent utilization

Duration of toasting(mins)	GE (kcal/kg)	DE (kcal/kg)	ME (kcal/kg)	%GE Digested	%GE Met	%DE Met
0	4927[a]	3842[a]	3448[d]	77.98	69.99[c]	89.74
10	4500[e]	3585[c]	3308[e]	79.67	73.52[a]	92.27
20	4706[d]	3760[b]	3454[c]	79.90	73.39[a]	91.86
30	4774[c]	3778[b]	3473[b]	79.14	72.75[b]	91.93
40	4820[b]	3849[a]	3548[a]	79.85	73.61[a]	92.18
50	4717[d]	3773[b]	3458[c]	79.99	73.31[a]	91.65
SEM	22.46	20.6	21.89	1.22	0.23	2.45

[a,b,c] Means within column with different superscripts are significantly ($P<0.05$) different. SEM standard error of the means. Met metabolized

Table 4a: Effect of fermentation with toasting on the proximate composition of *Lablab purpureus* (Rongai) beans.

Duration of fermentation/ toasting (Hrs/mins)	%Dry Matter	%Crude Protein	%Crude Fibre	%Ether extract	%Ash	%NFE
0	95.97	24.56[a]	11.96[a]	9.13[a]	3.85[a]	50.50[b]
24hrs + 10mins	95.07	21.06[b]	9.56[b]	5.94[b]	1.67[b]	61.77[a]
48hrs +10mins	94.93	20.69[b]	8.85[bc]	5.46[b]	1.48[b]	63.52[a]
72hrs +10mins	93.62	21.06[b]	9.48[b]	7.46[b]	1.19[b]	60.81[a]
SEM	1.45	0.98	1.65	1.43	0.21	3.65

[a,b,c] Means within column with different superscripts are significantly ($P<0.05$) different. SEM standard error of the means.

Results obtained showed a reduction in GE and DE for the fermented and toasted beans (table 4b). This could be attributed to nutrient loss from the combined effect of the two processing methods. According to (1, 10) this nutrient loss may be due to denaturation. However, there was a significant (P<0.05) improvement in both ME and percent utilization as a result of the combined processing methods.

Table 4b: Effect of fermentation with toasting on the GE, DE and ME values of *Lablab purpureus* (Rongai) beans and their percent utilization.

Duration of fermentation/ toasting (hrs/mins)	GE (kcal/kg)	DE (kcal/kg)	ME (kcal/kg)	%GE digested	%GE Met	%DE Met
0	4927^a	3842^a	3448^b	77.98	69.99^b	89.74
24hrs/10 mins	4795^c	3790^b	3458^b	79.04	72.11^a	91.24
48hrs/10mines	4769^d	3787^b	3467^b	79.41	72.71^a	91.55
72hrs/10mins	4899^b	3877^a	3548^a	79.14	72.43^a	91.51
SEM	10.23	10.23	10.12	0.84	0.78	0.55

^{a,b,c} Means within column with different superscripts are significantly (P<0.05) different. SEM standard error of the means.

Conclusion

It was observed that processing methods had effect on the proximate and energy composition of the beans.

1. There was a significant reduction in all the nutrients as the duration of the various processing methods increased.
2. Also the gross, digestible and metabolizable values were affected by the processing methods employed.
3. There was a corresponding reduction in the energy values as the duration of the processing methods increased. However the percent of the gross energy digested, metabolized and utilized increased in most part as the duration of processing increased.

References

1. Bawa, G.S. Tegbe, T.S.B. and Ogundipe, S.O. (2003). Effect of feeding graded dietary levels of Lablab seeds as a replacement for soyabean on performance characteristics of young pigs. Proc., 28th NSAP Conf., Ibadan, Nigeria, pp 230-232.
2. Abeke, F.O., Ogundipe, S.O., Sekoni, A.A., Dafwang,I.I. and Oladele, S.B. (2003) Effects of *duration of cooking* of lablab (lablab purpureus) beans on organ weights and blood parameters of pullet chicks. Proc. of the 28th Annual NSAP conference Ibadan, pp240-242

3. Ichaponani, J. (1980). Developing available and reliable test to predict biological availability of nutrients in poultry feed. Report of the Indian Council for Agricultural Research, New Delhi, India.
4. Association of Official Analytical Chemist. (AOAC) (1990). Official methods of analysis.(13th. Edition).Wahington D.C. USA.
5. Pauzenga U. (1985). Feeding Parent Stock. Zootechnica International, USA. December, 1985.
6. S.A.S. (1985). Statistical Analysis System Institute Inc. Users guide. Statistic Version 6th ed. Carry, North Carolina, USA.
7. Steel, R.G.D. and Torrie, J.H. (1980). Principles and practice of statistics. A biometric approach. 2nd ed. McGraw-Hill book Co. Inc. New York.
8. Ogundipe, S.O., Abeke, F.O., Sekoni, A.A,. Dafwang, I.I. and Adeyinka I.A. (2003) Effects of *duration of cooking* on the utilization of *Lablab purpureus*beans by pullet chicks proc. of the 28th Annual conf. of NSAP. Ibadan, Nigeria. Vol 28 pp233-235
9. Abeke, F.O. (2005). Evaluation of the nutritive value of lablab purpureus beans in replacinggroundnut cake in poultry diets. Ph.D. thesis, Animal Science Department, ABU, Zaria.
10. Akanji, A.M., Ologhobo, A.D., Emiola, I.A., Adedeji, T.A. andAdedeji, O.S. (2003). The effects of processing on haemagglutinin and other anti-nutritional factors in Jackbeans(*Canavaliaensiformis*) (L) (DC). Proc. 28th Ann. Conf.NSAP, Ibadan, Nigeria.Pp 189-193.
11. Akinmutimi, A.H. (2003). Effect of processing on metabolisability of energy content of Sword beans (Canavaliagladiata) using broiler chicks (starter phase). Proc. 28th NSAP Ibadan, Nigeria.Pp194-196.
12. Abeke, F.O., Amodu, J.T., Ogundipe, S.O., Sekoni, A.A. and Adeyinka, I.A. (2011). Effect of processing methods on the proximate composition of *Lablab Purpureus* (rongai) beans. *Proceeding of the 36th Annual Conference of the Nigerian Society for Animal Production* held at Merit House/Raw materials research and Development Council, Abuja. From13th – 16th March 2011. Pp. 734-736.