

EFFECT OF DURATION OF STORAGE ON NUTRITIVE VALUES OF LOCUST BEAN (PARKIA BIGLOBOSA) PULP

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ABSTRACT

Evaluation of the effect of storage duration on the nutritive values of locust bean pulp (LBP) was investigated. Three samples of LBP were used (freshly harvested, sample stored for 1 year, and 2 years respectively) Sub – sample from each was tied in a clean polythene nylon and kept in deep freezer until when needed for analysis. Results showed no significant ($P>0.05$) difference in crude protein and NFE contents of the 3 samples of LBP (CP 3.21, 4.90 and 3.79; NFE 59.01, 66.67 and 56.93 respectively. Magnesium and calcium content of LBP stored for the period of 1 year were not significantly ($P>0.05$) different from the fresh LBP and was significantly ($P<0.05$) higher than that of LBP stored for 2 years. Also, there were no significant ($P>0.05$) difference between the potassium and zinc content of the fresh LBP and the one stored for the period of two years. There was a significant ($P<0.05$) difference in the Vitamin contents across the storage durations. However, the result of Vitamin B₁₂ was statistically similar for the fresh LBP and the one stored for the period of 1 year and significantly ($P<0.05$) higher than the sample stored for 2 years. There was a linear increase in the total bacterial count with the period of storage, while the total fungal (yeast and mould) count followed a similar pattern with the percentage moisture content in the LBP samples. Organoleptic assessment of the pulp revealed a consistent change in the colour of the LBP in the order of Royal Yellow > Safety yellow > Golden brown colour respectively for the fresh, 1year and 2 years storage duration. Therefore, it was concluded that LBP could be preserved for off season utilization in feed formulation, because it is a promising cheaper alternative feedstuff in livestock ration.

Key words: Parkia biglobosa, Locust bean pulp , Storage duration, Nutritive values.

INTRODUCTION

What prompted the authors curiosity was the fact that, the availability of locust bean pulp is seasonal. Hence the sample used for this study was originally kept in the store for later use, with the foreknowledge of off season's scarcity; several bags were purchased during the period of harvest. Colour changes was observed as the pulp aged in the store, which then created more curiosity, to know if the locust bean pulp is still fit for use or to be discarded on the refuse bin.

The storage of feed is crucial to ensure better keeping quality of final feed. Physical characteristics of feedstuffs such as moisture content, which has the tendency to increase the likelihood of quality losses, deterioration, or spoilage is of great value before storing feedstuff (Jane, 2009) because, there may be changes in the chemical composition and nutritive value of feed during storage (Hossain, et al. 2011).The temperature and humidity, processing and handling of feed ingredients play a crucial role in fungi

contamination, growth and mycotoxin production during the pre and post – harvest periods. Generally, the moulds that contaminate poultry feeds result from the contamination of the feedstuff used in compounding the feed (Atanda, et al., 2013). Also, the climatic condition in the tropical environment is often characterized by high temperature and high relative humidity of over 25°C and 70% respectively (Adaga, 2014). Therefore, proper storage may help reduced nutrient deterioration. However, storage never enhances the quality of feed ingredients but proper storage maintains the shelf life of feedstuff. A good understanding of the nutrient's composition of feedstuff such as the moisture level, crude protein, energy and some macro minerals and vitamins will enable you to develop a suitable ration for your livestock. According to Susan (2003), the addition of additives in form of minerals, vitamins or medicines into feeds also influence storage time. The efficiency of most vitamins and some minerals will be reduced if the duration of storage exceeds 3 months. Generally, it is advisable to store feedstuff because heat combined with moisture from the feed will provide ideal conditions for spoilage (FAO, 2001). Storage method employed also determines how soon a particular feed or feedstuff will deteriorate. The locust bean pulp (LBP) which is commonly called “Dorowa” by the Hausas and Igba by the “Yorubas” and “ogiril” by the Igbos, “Nune” by the Tiv is a yellow floury pulp within which the famous locust bean seed (dawadawa) is embedded. The Locust bean pulp is of two major varieties the sweet type and the sour type. The use of locust bean pulp is a viable step toward recycling of the pulp. In the South western

part of Nigeria, it constitutes environmental pollution where the pulp is usually separated by washing in rivers causing an offensive odour. Afolayan, et al (2013 and 2014a) had earlier reported that the sourly taste of locust bean fruit pulp has beneficial effects on pullet's performance due to its high content of ascorbic acid and beta carotene and also calcium and phosphorus. Hence, locust bean pulp could be a potential source of energy, minerals and vitamins in livestock ration. Also, Locust bean pulp has been reported to have a positive effect on egg size and egg yolk colour of laying hens Afolayan, et al., (2014b) However, availability of LBP is seasonal, it is only available between the month of April-August, hence, there is the need to find solution to how to store it for off-season utilization. From personal observation, the pulp is hygroscopic in nature and tends to lose colour with prolong storage. This observation has necessitated the need to evaluate the possible effect of period of storage on the nutrient and chemical composition and the total bacteria and fungi load in the locust bean fruit pulp as a guide to Farmers and Researchers who may wish to store it for off season use. And also, to predict the possible consequence of incorporating such in livestock diets.

Materials and Methods

Three samples of locust bean pulp were used for this study, the first sample was the freshly harvested locust bean pulp, and this was obtained within the University Premises of Ahmadu Bello University, Zaria. The pulp was separated from the seed and pod. This sample served as the control. The second sample was obtained from the LBP that had

been stored in Bagco bag for 1 year, at the end of the 1-year sub samples were taken from different points inside the bag and then bulked together and tied in a clean polythene nylon and kept in deep freezer, while the third sample was also bagged and stored over the period of 2 years after then sub – sample from it was tied in a clean polythene nylon and kept in deep freezer until when needed for analysis. The storage period of LBP in bagco bag for the period of 1 and 2 years respectively was purposely done to imitate the common storage pattern employed by farmers.

Chemical analysis:

The three samples were subjected to proximate analysis according to the standard methods method described by AOAC (2012). The calcium and phosphorus content of the locust bean pulp was determined using atomic absorption spectrophotometry (Perkin Elmer model 03). Vitamin A, C, B₁ and B₁₂ were determined colorimetrically using a (GENESYS 10 UV spectrophotometer, Thermo Electron Corporation, England) at the Biochemical laboratory of the National Research Institute for Chemical Technology (NARICT), Bassawa, Zaria. Kaduna State.

Determination of Bacterial and Fungal count on the LBP

The bacterial and fungal viable cells count was determined using spread Nate method procedure. 10g of each sample was weighted and transferred aseptically in to the conical flask containing 9mls of sterile normal saline (stock solution), samples were allowed to soaked for few minutes. The mixture was shaken so as to mix thoroughly. 1mls was transferred aseptically in to a bottle containing

9mls normal saline (10^{-1} dilution), this was serially diluted until 10^{-6} dilution was obtained. 10^{-6} dilution were then spread Nate on the surface of sterile Nate of potato dextrose agar and Nate count agar were incubated at 37°C for 18-24 $^{\circ}\text{C}$ for 3-5 days. At the end of incubation period, bacterial colonies on Nate count agar were counted under microscopic light, while fungal colonies grown on potato dextrose agar were also counted. The result was recorded and expressed as colony forming unit per gram (cfu/g) using the formula below.

$$\text{Cfu/g} = \frac{\text{Total number of colonies counted} \times \text{dilution factor}}{\text{Volume of inoculants}}$$

Organoleptic Assessment of the Effect of Storage Duration on The LBP Colour

Evaluation of the colour changes in the three samples of LBP as affected by the storage duration was conducted with the aid of RGB Coulombmeter.

Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) and the means were compared using Duncan's Multiple Range Test (SAS, 2004) package. Descriptive statistics was used to explain the effects of storage duration on total bacterial and fungal counts.

Results and Discussion

The results obtained for the proximate analysis is as shown on (Table 1). The percentage moisture content of the three samples were within the normal moisture requirement for stored farm products and also corroborate the report by Hassan, et al. (2005)

who reported that low moisture (<15%) is desirable for feed storage because high moisture contents encourage microbial growth. However, duration of storage had a significant effect on the moisture content. The LBP sample stored for a period of 1 year had significantly ($P<0.05$) low moisture compared to the fresh sample and the one stored for two years, this may be due to the hygroscopic nature of the LBP. Crude Protein and NFE content of the three samples shows no significant ($P>0.05$) difference over the storage periods. This is an indication that duration of storage had no negative effects on the protein and energy content of the LBP, meaning that farmers may store LBP for off-season utilization. This observation disagreed with the report of Hossain, et al. (2011) who reported the possibility of changes in the chemical composition and nutritive value of feed during storage. There was no significant ($P>0.05$) difference between the LBP stored over the period of 2 years and fresh LBP in term of crude fibre and ash content, this suggest the possibility of storing LBP up to 2 years and confirming the fact that proper storage maintains the shelf life of feedstuff. Interestingly, the mineral contents were high across the various period of storage and it suggests that LBP can be stored up to two years without compromising the mineral contents. Ether extract of the fresh LBP was significantly ($P<0.05$) low (0.5%) when compared to the LBP stored over the period of 1 year (3.45%) and two years (3.90%). Table 2 shows the effects of duration of storage on some mineral component of LBP. It was observed that LBP is rich in vital macro and micro minerals and that duration of storage had significant effects on the levels of the

mineral components. This contradicts the report by Effiong, et al (2014) who observed that storage period has no significant effects on the nutrient components of feed samples. Magnesium and calcium content of LBP stored over the period of 1 year were not significantly ($P>0.05$) different from the fresh LBP and was significantly ($P<0.05$) higher than that of LBP stored for 2 years. It may be that magnesium and calcium content of the LBP begin to decline after exceeding 1 year in the store. However, there were no significant ($P>0.05$) difference between the potassium and zinc content of the fresh LBP and the one stored over the period of two years. This is an indication that the LBP can be stored up to 2 years and still retained the value of potassium and zinc in it. Nevertheless, the values obtained for phosphorus varies across the duration of storage, with the fresh LBP ranking first followed by the LBP stored for 2 years. The results obtained in this study is in consonance with the report by Kersten, et al., (2005). The authors reported the need for a precise evaluation of the quality of feed raw materials as this will determine the feed end-product quality.

Table 3 and figure 1 shows the result for the effects of storage duration on the vitamin contents of LBP. Vitamins B₁, B₁₂, A and C were selected for analysis because of their importance in animal feed as a growth factor and functions in metabolism, carotene levels and anti-stress respectively. For instance, Vitamin B₁ played a vital role in the conversion of food into energy, Vitamin B₁₂ is very important in the prevention of megaloblastic anemia that is responsible for body tiredness and weakness. Vitamin A is

essential for vision and also helps in the proper functioning of some vital internal organs, while Vitamin C helps in reducing oxidative stress (Verma, et al 2007, Quadros, 2010). There was a significant ($P < 0.05$) difference in the Vitamin contents across the storage durations. The result obtained for Vitamin A and C suggest that LBP could be stored up to 2 years without loss of value. However, the result of Vitamin B₁₂ was statistically similar for the fresh LBP and the one stored for the period of 1 year and significantly ($P < 0.05$) higher than the sample stored for 2 years. The significant increase observed for Vitamins B₁ in the sample stored for 1 year is an indication that if the value of the B Vitamins must be preserved in LBP, it should not exceed 1 year before utilization in feed formulation.

Figure 2: revealed the bacteria count (cfu/g) in the LBP samples. There was a linear increase in the bacteria count with the period of storage. The result gives an indication why the LBP should not be stored beyond 1 year except with the addition of preservative agents. However, the fungal (yeast and mould) count followed a similar pattern with the percentage moisture content in the LBP samples. There was a declined in the total fungal count (3.0×10^5 cfu/g) with low moisture content (8.9%) as observed in the LBP stored for 1 year. It is possible that the

fungi thrive well at higher moisture level. This observation corroborates the findings of Karel, et al. (2015) who reported that moisture content has significant effects on fungal growth. The significant ($P < 0.05$) increase in fungal count (5.3×10^6 cfu/g) observed in the fresh LBP may be due to the high humidity which was prevalent during the period of collection of the sample, because matured locust bean fruits is mostly available during the raining season. This observation agreed with the report by Viitanen, et al. (2010); Adan, et al. (2011) who reported that relative humidity coupled with the total amount of water present in the material may influence indoor fungal growth. However, fungi contamination observed in the fresh sample of LBP is also an indication that feedstuff may be contaminated at any period. This observation is in consonance with the report of Maciorowski, et al., (2006), who reported that feed materials may be contaminated during growing, harvesting, processing, storage and distribution period. Organoleptic assessment of the pulp (figure 4) revealed a consistent change in the colour of the LBP in the from Royal Yellow to Safety yellow to Golden brown colour for the fresh, 1 year and 2 years storage duration respectively. This may be due to the hygroscopic nature of the LBP which consequently enhances changes in the colour.

Table 1: Proximate Composition of Locust Bean Pulp (LBP) Stored Over Different Years

Parameters	Fresh	1 year	2 years	SEM
Moisture (%)	13.09 ^a	8.90 ^b	11.75 ^a	0.86
Crude Protein (%)	3.21	4.90	3.79	1.01
Crude Fibre (%)	4.20 ^a	1.10 ^b	3.60 ^a	1.01
Ash (%)	19.99 ^a	15.00 ^b	19.99 ^a	0.88
Ether extract (%)	0.50 ^b	3.45 ^a	3.90 ^a	0.86
NFE (%)	59.01	66.65	56.93	11.57

^{abc}= means along the same row with different superscripts are significantly different (P<0.05)

Table 2: Effects of Storage Duration on the Mineral Contents of Locust Beans Pulp

Parameters	Duration of storage			SEM
	Fresh	1 years	2 years	
Magnesium (g/kg)	0.73 ^a	0.82 ^a	0.55 ^b	0.07
Potassium (g/kg)	3.70 ^a	3.11 ^b	3.82 ^a	0.07
Calcium (g/kg)	4.34 ^a	5.46 ^a	3.45 ^b	0.57
Phosphorus (mg/l)	17.81 ^a	13.10 ^c	15.20 ^b	0.10
Zinc (g/kg)	0.07 ^b	0.11 ^a	0.07 ^b	0.00

^{abc}= means along the same row with different superscripts are significantly different (P<0.05)

Table 3: Effects of Storage Duration on the Vitamin Contents of Locust Beans Pulp

Parameters	Duration of Storage			SME
	Fresh	1 years	2 years	
Vitamin A (mg/g)	8.60 ^c	9.10 ^b	9.88 ^a	0.35
Vitamin C (mg/g)	0.14 ^b	0.64 ^a	0.51 ^a	0.09
Vitamin B ₁ (mg/g)	6.51 ^b	26.88 ^a	8.78 ^b	3.30
Vitamin B ₁₂ (mg/g)	32.81 ^a	33.17 ^a	8.38 ^b	4.11

^{abc}= means along the same row with different superscripts are significantly different (P<0.05)

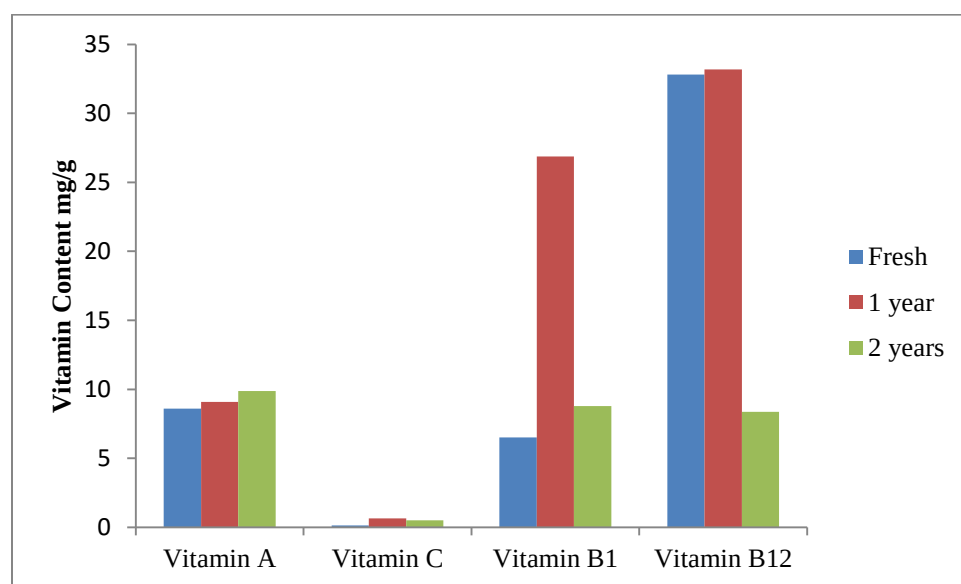


Figure 1 : Effect of storage duration on Vitamin contents of LBP.

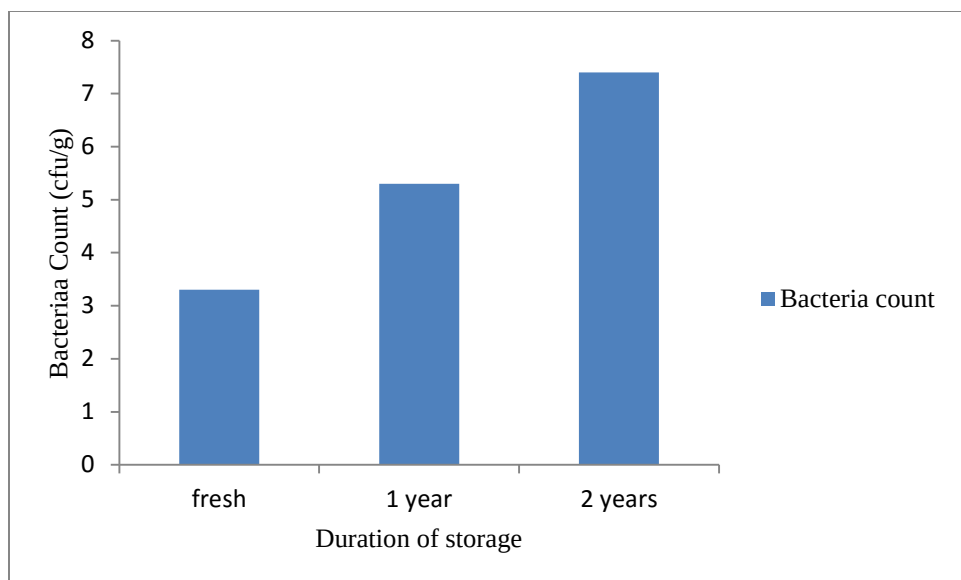


Figure 2: Effects of Duration of Storage on Total Bacteria Count in LBP

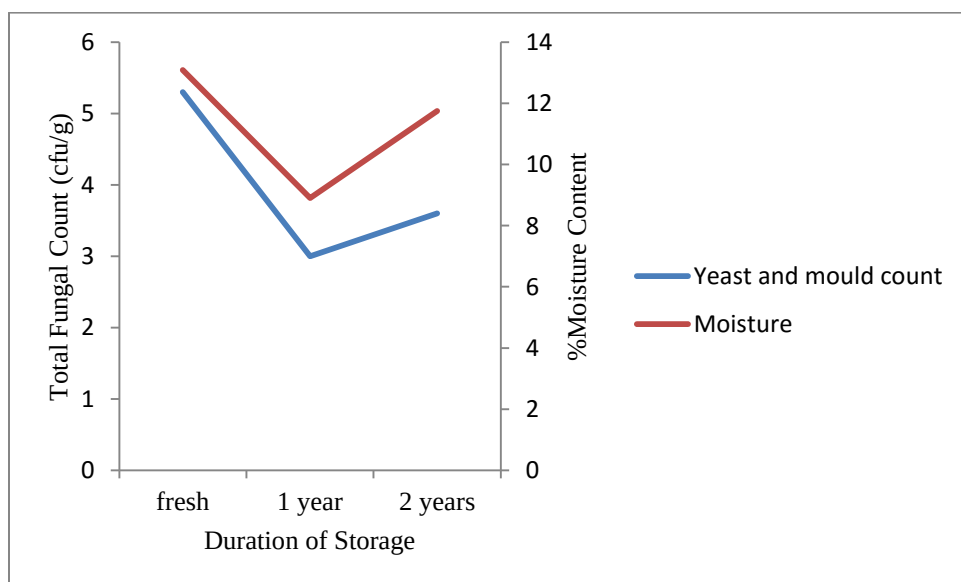


Figure 3: Effect of Duration of Storage and Moisture Content on Total Fungal Count in LBP



Plate A

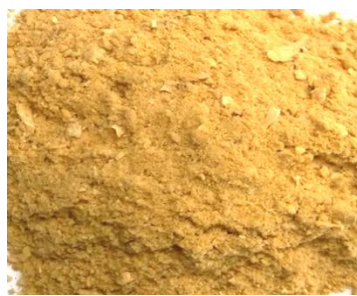


Plate B



Plate C

Figure: 4 : Effect of Duration of Storage on the colour change of Locust bean pulp:

Plate A	Fresh pulp (Royal yellow colour)
Plate B	LBP stored for a period of 1 year (Safety yellow colour)
Plate C	LBP stored for a period of 2 years (Golden brown colour)

CONCLUSION

Within the scope of this study, it was concluded that:

- 1) Locust bean pulp could be preserved for off season utilization in feed formulation since some of its nutritive contents such as; Crude protein, NFE, Vitamins A and C, potassium and zinc were not affected by the storage period.
- 2) Bacteria contamination increases with the period of storage of LBP; however, fungi contamination was predominant in the fresh sample used in this study. This is an indication of possibility of contamination at any period of time.
- 3) The storage period enhances changes in the colour of the LBP from royal yellow (fresh sample) to safety yellow (sample stored for a period of 1 year)

and finally to golden brown colour (sample stored for a period of 2 years).

RECOMMENDATION

- 1) Considering the cheapness of the LBP and the nutritive value as alternative feed resource, further research is therefore recommended on the use of preservatives such as organic acid or anti – fungal or even toxin binder to preserve the LBP and also to prevent bacteria and fungi contamination of the finished feed.
- 2) Because of the hygroscopic nature of the LBP and consistent changes in colour air- tight bags may be used for storage after treatment with anti fungi so as to improve the general acceptability and shelf life

of the LBP that is to be store for more than a year.

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- 3) For subsequent research on long term storage of locust bean pulp, sub - sample should be replicated before laboratory analysis so as to ascertain the precise quality of the sample during the different period of storage.

Afolayan, M., Bawa, G.S., Sekoni, A.A. Abeke, F.O. and Adeyinka, I.A. (2014b). Effect of graded levels of locust bean pulp on the response and egg quality parameters of laying hens. *Journal of Animal Production Research* 26: 1-12.

REFERENCES

Adaga, K. (2014). Nutrient profile of some commercial feeds under different storage conditions and their effect on growth performance of *Clarias gariepinus*. MSc. thesis submitted to Department of Fisheries and Aquaculture, University of Agriculture, Makurdi Nigeria. Pg. 125.

Adan, O.C.G., Huinink, H.P and Bekker, M. (2011). Water relations of indoor fungi. In *Fundamentals of Mol Growth in indoor Environments and strategies for Healthy Living*. Wageningen Academic Publishers, 41-65

Afolayan, M., Bawa, G.S., Sekoni, A.A. Abeke, F.O., Afolayan, S.B. and Odegbile, E.O. (2013). Performance of growing pullet fed graded levels of locust bean pulp as a source of energy. *Journal of Animal Production Research* 25: 18-24.

Afolayan, M., Bawa, G.S., Sekoni A.A., Abeke F.O. Inekwe V.O. & Odegbile E.O. (2014a). Phytochemical and Nutritional Evaluation of Locust Bean Fruit Pulp. *Journal of Emerging Trends in*

AOAC (2012): Official methods of analysis, Association of Official Analytical Chemists. 19th Edition. AOAC International, Arlington, Virginia, USA.

Atanda, O., Makun, H.A., Ogara, I.M., Edema, M., Idahor, K.O., Eshiett, M.E. and Oluwabamiwo, B.F. (2013). Fungal and mycotoxin contamination of Nigerian foods and feeds, mycotoxin and food safety in developing countries Hussaini Makun (ed.), In *Tech*, DOI: 10.5772/55664.

Effiong B., Nyong, F. and Janet O. (2014). Effect of Storage and Anti-Nutritional Components in Stored Pelleted Fish Feed. *International Journal of Science, Technology and Society*. 2(6), 186-189. doi: 10.11648/j.ijsts.20140206.14

FAO. (2001). How should I store my feeds? In feeds and feeding of fish and shrimp. FAO Coporate document repository. Fisheries and aquaculture Department Rome, Italy.

Hassan, L. G., Umar, K. J., Adeyemi, J. O. and Muhammed, A. S. (2005). Physico-Chemical Analysis of *Albizzia lebbek* (L.) seeds and oil. *Bulletin of Science Association of Nigeria*,

- 26: 368-372. ISBN. 978- 92-5=106654-6.
- Hossain, M. S., Kabiraj, R. C., Hasan, M. A., Shaheen, M. R. U. B., and Al-Azad, M. A. K. (2011): Effect of biotic and abiotic factors on quality of black gram seed. Bangladesh
- Jane, A. P. (2009). Feedstuff Handling, Storage, And Feeding Systems for Livestock. Published to the web on October 8, 2003. Last Reviewed / Revised on April 22, 2015.
- Karel, A. L., Hendrick, P. H., Frank, J.J.S., Jan, D. and Olaf, C.G.A. (2015). Separate effects of moisture content and water activity on the hyphal extension of *Penicillium rubens* on porous media. Published by Society for Applied Microbiology and John Wiley & Sons LTD. Environmental Microbiology 17(12), 5089-5099.
- Kersten, J., Rohde, H.R. and Nef, E., (eds) (2005). Principles of mixed feed production: components, processes, technology. Bergen / Dumme, Germany, Agrimedia. Pg 350
- Maciorowski, K.G., Herrera,P., Jones, F.T., Pillai, S.D. and Ricke, S.C. (2006). Effects on poultry and livestock of feed contamination with bacteria and fungi. Animal Feed Science and Technology. 133 (1): 109- 136.
- Quadros, E.V., (2010). Advances in the understanding of Cobalamin Assimilation and metabolism. British Journal of Haematology 148, 195-204. Available online at [https// doi.org/10.1111/j.1365-2141.2009.07937.x](https://doi.org/10.1111/j.1365-2141.2009.07937.x).
- S.A.S. (2004). Statistical Analysis System Institute, User's Guide. Version 9 for Windows. North Carolina, U.S.A.
- Susan M. (2003). Ag-Info Centre, Alberta Agriculture & Rural Development. Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Research Publications Journal. 5, 103-110.
- Viitanen, H., Vinha, J., Salminen, K., Ojanen, T., Peuhkuri, R., Paajanen, L. (2010). Moisture and bio-deterioration risk of building materials and structures. Journal of building Phys 3: 201-224.
- Verma, R.S. Mhta, A, Strivastava, N. (2007). In Vivo Chlorpyrifos Induced Oxidative Stress Attenuation by Antioxidant Vitamins. Pesticide Biochemistry and Physiology 88, 191-196.