Food Science and Quality Management
ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online)
Vol.28, 2014
www.iiste.org

Effect of Breadfruit Based Complementary Food on Weight and Haematological Parameters in Albino Rats.

Adepeju, A. B.[1], Gbadamosi S.O.[2], Omobuwajo, T.O.[2] and Abiodun O.A.[1]
[1]Department of Food Science and Technology, Osun State Polytechnic, Iree
[2]Department of Food Science and Technology, Obafemi Awolowo University, Ile-Ife
Corresponding Author E mail: adepejuadefisola@gmail.com

Abstract
In this study, the effect of breadfruit based complementary food on weight and hematological parameters was investigated. In the study forty- five (45) albino rats (Wistar strain) were randomly distributed into metabolic cages (8 groups) of 5 rats each, they were adapted to a diet containing 4% casein for a period of five days. After the acclimatization period the animals were then re-weighed and regrouped. The average weight per group was approximately the same. One group of five animals served as control for the experimental group and blood samples were collected. The 6 grouped animals were placed on the diets formulated for a period of 28 days; while a group of 5 animals were placed on a commercial complementary food. Water and food were supplied ad libitum. Blood samples were collected through cardiac puncture at 0, 14 and 28 days for hematological parameters analyses. The results showed that there is significant increases ($p>0.05$) in the level of the total WBC (White Blood Cell) count, platelet count and PCV (Packed Cell Volume) when compared with the control group. The results suggested that incessant consumption of the complementary food may be advisable.
Keywords: Breadfruit, Complimentary diet, Formulation, Hematological, Weight,

Introduction
Breadfruit (Artocarpus altilis) is one of the local staples in the developing countries, although relatively cheap and nutritious but neglected (Akanbi et al., 2009). Breadfruit has potential for complementary food formulations. It belongs to Mulberry family Moraceae. It is a tropical fruit and the tree produces fruit twice a year, from March to June and July to September with some fruiting throughout the year (Omobuwajo, 2007). It has also been an important staple in Caribbean and Malaysia. It is one of the principal sources of energy, protein, vitamin and minerals for millions of the poorest people of these regions (Tuivavakgi and Samuelu, 2007). It's nutritive value especially carbohydrate, protein, fat and mineral contents is comparable with or even superior to some cereal food grains (Adebowale et al., 2008). Breadfruit is of high protein quality unlike most cereals especially maize which is generally recognized as being inherently poor in protein quality (Omobuwajo, 2007; Uvere et al., 2002).

Breadfruit has been recognized as a nutritionally beneficial fruit by many citizens and communities and is also culturally important for many people across the world. It is an energy booster and is high in fibre content; the fibre content in breadfruit helps in decreasing cholesterol and triglycerides that causes several heart diseases (Ramdath et al., 2004). Consumption of breadfruit lowers the LDL (harmful cholesterol) in the body and elevates HDL (good cholesterol) count, protecting the risk of heart attack (Roberts-Nkrumah,1997).
Research attention on breadfruit as focused majorly on the production of cracker, stiff porridge and biscuit. Information on the effect of breadfruit on the blood cells has not been well established. Therefore, the aim of this work was to scientifically investigate the effect of breadfruit based complementary food on weight and hematological parameters using albino rats as a case study.

Materials and Methods
Materials
Mature but unripe breadfruit (Artocarpus altilis), soybeans (Glycine max) and groundnut (Arachis hypogeal) were obtained from the Central Market in Ile Ife, Osun State, Nigeria. A commercial complementary food, (CCF) was purchased from Glory 2 Glory Supermart in Ile-Ife, Osun State.
Methods
Formulation of Experimental food.
The dietary blends were formulated at the ratio 100:0:0 (Diet 1), 80:10:10 (Diet 2), 80:5:15 (Diet 3) 80:15:5 (Diet-4) (Breadfruit: Soybeans: Groundnut), 80:20 (Breadfruit: Soybeans) (Diet 5) and 80:20 (Breadfruit: Groundnut) (Diet 6) in accordance with the recommendation of World Health Organization (FAO/WHO/UNU,1991). In addition mineral and vitamin mixture were blended with the experimental diets according to Ikujenlola (2008) method. A commercial complementary food with vegetable based protein was used in this work as a control for the formulated diets.

Experimental Animals

Forty-five weanling albino rats (Wister strain)of both sexes were weighed and randomly distributed into nine groups of 5 animals each. The average weight per group was approximately the same. A group of the animals served as zero-day animal for the experimental groups. Blood were collected from them through cardiac puncture. The animals were kept in spacious and well ventilated metabolic cages with suitable temperature, relative humidity; food and water were supplied ad libitum for 28 days. Blood samples were also collected on 14 and 28-day.

Experimental procedure

This study was carried out on 9 groups of rat (n=5). Blood samples were collected from zero-day group. The test groups were given different formulated diets (Diet 1, 2, 3, 4, 5 and 6) while the control group was given a commercial baby food (Diet 7). Fourteen and twenty-eight days blood samples were collected into EDTA capped bottles with the aid of a 5ml syringe The blood samples were then analyzed for hematological parameters.

Determination of hematological parameter.

The counting of total white blood cells was done after the method of Brown (1974) using a diluting fluid (Turk's fluid) in a ratio of 1:20. Packed cell volume (PCV) was done using the Macrohaematocrit method (Dacie and Lewis, 2001; Durosimi, 2005).

Statistical analyses

All data were presented as mean ± SEM. The one way ANOVA was used to analyze the data, followed by posthoc test (LSD). The result were considered significant at $P<0.05$.

Results and Discussion.

Weights of various tissues of the experimental animals

The animals that depend on the basal diet for survival were found to become leaner and weaker each passing day of the experiment. Changes were observed on the skin, disposition and in their consumption rate. Loss of weight was dramatic from 51.36 g at day one to 38.43 g at the twenty-eighth day (there was loss of an animal in this group). On the other hand, the animals fed with other formulated diets increased in weight. The rates of growth in the respective groups during the experiment were given in Figure 1. Compared with the commercial product, feeding with the mixtures of vegetable proteins, favorable growth rate was apparent, while the use of the individual proteins was associated with satisfactory weight gain. Actually, the differences in growth rates were significant with commercial diet compared with the individual proteins (soybean and groundnut) and mixed vegetable proteins from the 10^{th} day of the experiment. Significant difference between growth rates of animals fed the mixed diet and the individual proteins commenced only after the 16^{th} day. No significant difference however was observed between the animals fed, the control and the mixed diets throughout the experiment except on the last day. The food intake and changes in the body weights may be influenced by the source of nitrogen and this was in accordance with the report of Obizoba (1991) that the food intake and the changes in the body weights were influenced by the source of nitrogen and varietal differences in soybeans and groundnut which were combined with breadfruit (Table 1). The rate of consumption of the diets is shown in the Appendix. The rate at which the formulated (except basal) and control diets were consumed by the animals were high throughout the experiment.

Table 2 shows the mean weights of Liver, kidney and Muscle (plantaris) of the experimental animals. The liver of the rats ranged from 1.68 (basal diet) to 3.56 (diet 5). The sizes of the organs under consideration are related to the body weight of the experimental animals. The kidney size ranged from 0.30 (basal diet) to 1.00 (breadfruit + 20% groundnut), while the muscle (plantaris) size ranged from 0.30 (basal) to 1.46 (breadfruit + 20% groundnut). Generally, the tissues collected from the animals fed on basal diet were found to be very small and indeed much smaller than those of animals from other experimental groups. The livers were pale. There was large fat deposition in and around the adipose tissues of all the animals in the control (commercial) group because of its composition.

Growth Performance of the Experimental Animals

The growth performance of the experimental animals fed with the formulated complementary diets and control diet is presented in Figure 1. The mean weight gain ranged between 62.32g (GP2 animals fed on diet 2) and 83.20 g (GP5 – animals that fed on diet 5). The weight of animals fed on basal diet decreased with time as reported by Fashakin et al. (1991)

An animal even died in this group. The increase in weight displayed by animals in other groups was in varying proportion. The weight gained was largely influenced by the quality of the protein constituents of the diet. Protein is required among other things for good growth, healthy living, maintenance and production of cell and tissues of the body. Groundnut alone fortified breadfruit diet supported best weight gain among the formulated complementary diets while the mixed diet at 10% level (Breadfruit + 10% soybeans +10% groundnut) supported least weight gain. Inclusion of legume flour improved growth and enhanced weight gain in the diet. Compared with the commercial product, feeding with the mixtures of vegetable proteins enhanced favourable growth rate, while the use of individual protein was associated with satisfactory weight gain. Significant difference between growth rate of animals fed with mixed diet and the commercial diet commence towards the end of the experiment.

Tables 3 and 4 showed the values of PCV, WBC and platelets of the experimental animals fed on the formulated diets for 14^{th} and 28^{th} days. The PCV ranged from 22.00% (basal) to 50.67% (Diet 3).These values showed that PCV significantly increased in the test groups compared with the zero-day group at P>0.05. The PCV of the experimental animals fed with the formulated diets were significantly higher than the PCV of the experimental animals fed with basal diet (protein free diet). According to Mitruka and Rawnsley (1977) and Amamfule et al., (2006), the normal range and mean PCV for rabbit are 25.0-45.0 and 34.0 respectively. The entire test group except the protein free diet (Diet 1) fell within the normal range. The PCV measures the ratio of the volume occupied by red cells to the volume of whole blood in a sample of capillary or venous blood (Hercberg et al., 1991, Annan and Plahar, 1995). It measures the percentage by volume of packed red blood cells in a whole blood sample after centrifugation (Wynne and Edward, 2003).It is a convenient and rapid measure of the degree of anemia and from a nutritional standpoint, provides information comparable to the haemoglobin concentration.

The PCV levels of the formulated diets except the basal diet were all above the cut –off levels for infants and children. The cut-off levels ranged from 32% in children age 0.5 to 4 years to 40% in males above 15 years (Herberg et al., 1991). An anemia situation results when PCV is far below the cut off level. It can be deduced that the formulated diets except basal produced significant increase in the production of PCV and hence RBC by the bone marrow. This is useful in increasing the oxygen carrying capacity hence, increasing tissue oxygenations. The WBC of the diets varied from 1.80 $\times 10^3/m^3$ (Diet 4 group-Basal +15% soybeans +5%groundnut) to 2.70$\times$ $10^3/m^3$(zero-day animals).The WBC of the basal diet is higher than the WBC of all other formulated diets. The normal range of WBC for rabbit according to Mtruka and Rawnsley (1977) is 3.000-6.000. The normal mean is 4.000$\times$10 $^3/m^3$. Diet 2, 4 and 6 had lower WBC than the normal mean whereas diets 1,3 and 5 were within the normal means.

WBC count is the number of white blood cell in a cubic millimeter of whole blood and is usually important in fighting against infections (Schalm et al.,1975).The PCV,WBC and platelet counts were analyzed in the middle of the study (14^{th} day).It was observed that the experimental groups. It can be deduced that the PCV increases as the days of feeding of the experimental animal continues. This means that the formulated diets produced significant increase in PCV and hence increase in the production of RBC by the bone marrow(Annan and Plahar,1995). WBC is higher than what was observed on the 28^{th} day of the study .WBC decreased as the study progresses. The significant decrease in WBC at the end of the study indicates low levels of infection in the experimental rats. The platelets on the 14^{th} day were higher than at the expiration day of the study. Normally high platelet count will lead to increase in bleeding and decrease in clotting time. This problem is alleviated with reduction in platelet as the study progresses .This is an indication that the formulated diets can support the well-being of the infant. Therefore the outcome of this study revealed that the presence of breadfruit based diet significantly stabilized all blood cells.

Conclusions

It can be suggested that the presence of breadfruit based diet as reported in this study normalized /alleviated haemotopoiesis of all blood cells; therefore consumption of this diets by infant is advisable.

REFERENCES

Adebowale, A.A, Sanni, S. A and Oladapo, F.O (2008) Chemical, Functional and Sensory properties of instant yam-breadfriit flour. Nigerian Food Journal, 26, 1, 2-12.

Akanbi, T.O,Nazamid,S. and Adebowale, A.A (2009) Functional and Passting properties of a tropical breadfruit(Artocarpus altilis) starch from Ile- Ife, Osun State, Nigeria. International Food Research Journal, 16, 151-157.

Amamefule,K.U,Onwudike,O.C, Ibe ,S.N and Abasiekong S. F. (2006) Performance, cost benefit carcass quality and organ characteristics of pigs fed high graded levels of brewers' dried gram diets in the humid tropics. Pakistan Journal of Nutrition, 5, 3, 242-247.

Annan, N.T and Plahar, W.A (1995). Development and quality evaluation of a soy fortified Ghanaian weaning food. Food and Nutrition Bulletin, 16, 3, 263-267.

Brown, K. H. (1974) Appropriate diets for the Rehabilitation of malnourished children in the community setting. Acta Paediatric Scanel. 374, 151-159.

Dacie, J.V. and Lewis S.M. (2001) Practical Haemotology 11th edn. Pp11-17, Longman Group Ltd. Hong Kong.

Durosimi (2005) Haematology and Immonology practical guide for Dental and Medical students. Department of Haematology immunology, Obafemi Awolowo University, Ile- Ife. 4-10

FAO/WHO/UNU,(1991) Energy and Protein Requirements. Report of a joint FAO/WHO/UNU. Export Consultation. World Health Organisation. Technical Report Series. 724:86-98.
Fashakin, J. B., Ilori, M. O. and Olarewaju, I. (1991) Cost and Quality Optimization of a complementary diet from plant protein and corn flour using a computer aided linear programming model. Nigerian Food Journal. 9, 123-126.
Hercberg, S.,Galan Pe, Dhur, A.(1991) Essential mineral and trace element nutritive methodology for assessing iron deficiency in fladanza faed. Nutritional status assessment. London: Chapman and Hill. 374-385.
Ikujenlola, A. V. (2008).Chemical and Functional properties of complementary food from malted and unmalted Achay soybean and defatted sesame seed. Journal of Engineering and Applied sciences, 3, 6, 471-475.
Mitruka, B. M. and Rawnsby, H.M.(1977).Clinical Biochemical and Haemotological reference values in normal experimental animal. Masson Publishers co. N.Y.102-107.
Obizoba, I.C. (1991). Effect of Sprouting on the nitrogenous constituents and mineral composition of Pigeon Pea (Cajanus cajan)Seed Plant Foods Human Nutrition, 41, 21-26.
Omobuwajo, T.O.(2007) Overview of the status of Breadfruit in Africa. Acta Horticultural, 757, 61-63.
Ramdath , D.D., Isaac, R.I.C, Teelucksigh,S. and Wolevar, T.M.S (2004) Glycemic index of selected staples commonly eaten in the Caribbean and the effects of boiling v crushing, British J. Nutrition.
Roberts-Nkrumah, L. B. (1997) Towards Description of the Breadfruit Germ Plan in St. Vincent Fruit. 52, 27-35.
Schalm, O.W, Jain, N.C. Carrol, E.J. (1975) Veterinnary haematology, 3rd Edition, Lea an d Febiger, Philadephia, Pp 421-435.
Tuivaralagi, P. and Samuelu, L.(2007) Breadfruit in Samoa:the past, some recent studies current Activities and Future Potential. Acta Horticultural. 757, 233-237.
Uvere, P.O, Ngoddy, P.O. and Nnauyelugo, D. O.(2002) Effect of amylase-rice flour (ARF) treatments on the viscosity of fermented complementary foods. Food and Nutrition Bulletin, 23, 2, 90-199.
Wynne, H. A. and Edward, E (2003). Laboratory data .In :Clinical pharmacy and therapeutics by Roger w, clive, 3rd ed. 4:58-61.

Table 1: Food Intake of the Experimental Animals during Feeding Experiment.

Sample	Food Intake (g)
Diet 1	98.93±0.11
Diet 2	121.94±0.08
Diet 3	121.50±0.42
Diet 4	114.95±0.08
Diet 5	150.85±0.20
Diet 6	132.67±0.47
Diet 7	148.73±0.38

Means of the same column followed by different letters are significantly different ($p < 0.05$)
Note: Diet 1 (Basal), Diet 2 (Breadfruit + 10% Soy + 10% Groundnut), Diet 3 (Breadfruit+ 5% Soy+15%Groundnut), Diet 4 (Breadfruit+15% Soy+5% Groundnut), Diet 5 (Breadfruit + 20 % Groundnut), Diet 6, (Breadfruit + 20% Soy), Diet 7 (Control)

Table 2: Weight of various tissues of experimental animals in grams

Dietary Sample	Liver	Kidney	Plantaris Muscle
Diet 1	1.68±0.06	0.30±0.04	0.38±0.01
Diet 2	3.00±0.35	0.36±0.01	0.44±0.02
Diet 3	3.08±0.01	0.38±0.01	0.48±0.01
Diet 4	3.10±0.04	0.38±0.03	0.48±0.01
Diet 5	3.56±0.06	1.00±0.35	1.46±0.03
Diet 6	3.42±0.04	0.66±0.02	0.64±0.03
Diet 7	3.24±0.02	0.50±0.04	0.58±0.03
Control (at zero-day)	1.92±0.06	0.18±0.01	0.30±0.05

Note: Diet 1 (Basal), Diet 2 (Breadfruit + 10% Soy + 10% Groundnut), Diet 3 (Breadfruit+ 5% Soy+15%Groundnut),
Diet 4 (Breadfruit+15% Soy+5% Groundnut), Diet 5 (Breadfruit + 20 % Groundnut)
Diet 6 (Breadfruit + 20% Soy), Diet 7 (Control)

Table 3: Hematological parameters in control and the breadfruit based complementary food fed groups of rats (n=5) at 14th day.

Hematological parameters	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet6	Diet 7
PCV (%)	29.60±0.40a	46.00±0.30g	54.50±0.50f	41.00±0.30e	42.00±0.52d	39.50±0.50c	39.00±0.35b
WBC ($\times 10^3/m^3$)	2.80±0.01f	3.00±0.02e	2.50±0.04b	2.40±0.05a	3.80±0.40f	2.80±0.20d	2.60±0.03c
Platelets ($\times 10^3/m^3$)	185.83±2.74 a	171.00±1.00 a	178.00±0.50 a	149.00±0.30 a	161.00±0.50 a	158.00±1.00 a	158.00±2.00 a

Table 4: Hematological parameters in control and the breadfruit based complementary food fed groups of rats (n=5) at 28th day.

Hematological parameter	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7	Zero-day
PCV (%)	22.00±0.40 a	40.67±0.58d	50.67±0.58e	39.00±1.00c	40.00±6.10c	37.50±0.50b	38.00±0.10bc	20.00±1.00b
WBC($\times 10^3/m^3$)	3.45±0.20 f	2.70±0.10 c	3.00±0.30 d	1.83±0.06 a	3.10±0.00 e	2.65±0.05 bc	2.60±0.00 b	2.70±0.04 g
Platelet($\times 10^3/m^3$)	141.00±1.30a	165.57±1.51e	180.50±3.50f	148.00±1.00b	184.50±3.50g	154.00±0.58c	158.00±1.00d	110.50±5.00a

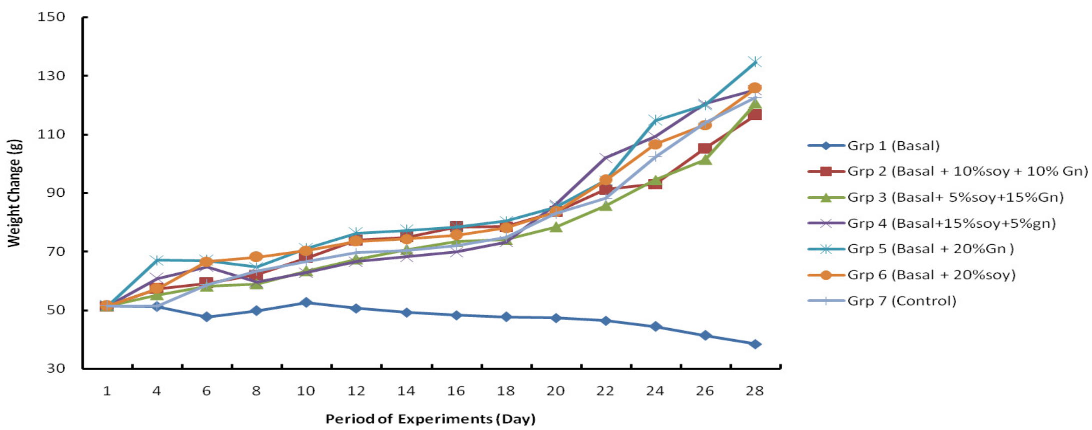

Figure 1: Weight Changes of the Experimental Animals

Note: Diet 1 (Basal), Diet 2 (Breadfruit + 10% Soy + 10% Groundnut), Diet 3 (Breadfruit+ 5% Soy+15%Groundnut), Diet 4 (Breadfruit + 15 % Soy + 5 % Groundnut, Diet 5 (Breadfruit+20%Groundnut),Diet6(Breadfruit+20%Soy)Diet7(Control)