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Effect of dry heat treated jackfruit seed powder on growth of experimental animals

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Abstract: *The objective of the present study was to found the effect of using roasted jackfruit seed powder in different proportion on growth of the experimental animals. Twenty seven male albino rats were divided into 3 groups. Control group was fed on stock diet. 65% and 22.5% of dry heat treated jackfruit seed powder was mixed in supplementary food (SF) A and B respectively. Treated group A and B were fed on SF A and SF B respectively for 4 weeks. Severe growth retardation was seen in group fed on diet containing 65% of dry heat treated jack fruit seed powder. But usage of the powder in 22.5% level has been found to impart comparable growth with control group. Liver weight and liver function tests did not reveal any adverse effect in experimental animals. Therefore it can be said that small to moderate proportion of dry heat treated jackfruit seed powder can be used to develop any food products .*
Key Words: *Dry heat, Jackfruit seed powder, Albino rat, growth pattern*

I. Introduction

Jackfruit *(Artocarpus heterophyllus)* is a species of tree in the mulberry family (*Moraceae*), which grow abundantly in India, Bangladesh, and in many parts of Southeast Asia[1] . The large seeds from this nonleguminous plant are also edible, A single seed is enclosed in a white aril encircling a thin brown spermoderm, which covers the fleshy white cotyledon. Jackfruit cotyledons are fairly rich in starch and protein[2] . Jackfruit seeds are normally discarded or sometimes kept for consumption. Jackfruit seeds, which appeal to all tastes, may be roasted and eaten as a snack or boiled and used as an alternative to potato or used in some local dishes[3].

As jack fruit is highly seasonal and seeds have shorter shelf life, hence go waste during the seasonal glut. Roasted, dried seeds are ground to make flour . So, the seed flour can be an alternative intermediatory product, which can be stored and utilized, both for value addition and to blend with other grain flours like wheat flour without affecting the functional and sensory profile of the final product.

Jackfruit seed contains lignans, isoflavones, saponins, all phytonutrients and their health benefits are wide-ranging from anticancer to antihypertensive, antiaging, antioxidant, antiulcer, and so on[4]. Jackfruit seed powder has the ability to relieve discomfort due to indigestion. Jackfruit seed extract was found to inhibit the proteolytic activities of different animal pancreatic preparations effectively[5]. Seeds also contain 2 lectins namely jacalin and artocarpin. Jacalin, the major protein from A. heterophyllus seeds, has been proved to be useful for the evaluation of the immune status of patients infected with human immunodeficiency virus 1[6]. Jackfruit seeds can also be developed into therapeutic agents capable of treating infectious diseases and preventing food contamination by food-borne pathogens as nanosized particles of Jackfruit seeds proved to have antibacterial effect[7]. Jackfruit seeds could be processed into dual-functional food ingredients possessing antimicrobial activities.

Table no 1: Nutritive value of fresh jackfruit seeds and jackfruit seed flour:

Nutrient	**Nutritive value of fresh jackfruit seeds (per 100 g of edible portion)[12]**	**Nutritive value of jackfruit seed flour (per 100 g)[13]**
Moisture (g)	64.5	6.09
Protein (g)	6.6	13.50
Fat (g)	0.4	1.27
Minerals (g)	1.2	2.70
Fibre (g)	1.5	3.19
Carbohydrate (g)	25.8	79.34
Energy (kcal)	133	382.79
Calcium (mg)	50	308.7

Iron (mg)	1.5	13.07
Magnessium (mg)	54	338.0
Sodium (mg)	63.2	6.06
Potassium (mg)	246	1478.1
Copper (mg)	0.19	1.45

The flour had good capacities for water absorption (205%) and oil absorption (93%)[8]. Chemical Properties of Jackfruit Seed Flour has great potential in the food industry, especially as thickener and binding agent in various food systems. Jackfruit seed flour had been used in bread preparation substituting wheat flour[8]. Beside this the seed flour had also been used with de-fatted soy flour mix to prepare breakfast cereal by twin-screw extrusion technology[9.] But here in the present study jackfruit seed powder has been used to develop a low cost supplementary food along with some other neglected food parts.The objective of the present study is to find out the effect of using roasted jackfruit seed powder in different proportion on growth of the experimental animals.

II. Materials and Methods

Experimental rats and management: Twenty seven young male Wister albino rats having body weight ranging from 70-80gm were selected for the present experimental study. The animals were acclimatized in the laboratory for one week before initiating the experiment. They were fed on standard diet and water *ad libitum.* Wister albino male rats were randomly divided into three groups namely control(coded as C) treated group-A (coded as TA) and treated group-B(coded as TB). Each group had nine rats. The rats were kept in individual cages under normal environmental conditions. During experiment control group was fed on stock diet whereas treated groups were offered newly developed supplementary formula A and B (coded as SF A and SF B) for 28 days. Water and food was offered on a daily basis.

Preparation of different diets: Stock diet was prepared by mixing wheat flour, skimmed milk powder, roasted bengal gram flour, wheat bran and ground nut oil.

Jack fruit seed powder was used to develop two supplementary formulae. Jackfruit seeds were sorted and cleaned with water and white arils (seed coat) were manually peeled off. After cleaning these seeds were kept for shade dry overnight. Dry seeds were grinded manually and then roasted in non stick pan at 70-80 degree centigrade on low flame for 20 minutes to avoid burning. Roasted jackfruit seeds were powdered using electric grinder and were passed through 0.5mm/0.02" mesh sieve to obtain powder.

Jackfruit seed powder was mixed with watermelon seed powder, drumstick leave powder and fish bone dust in different percentage to develop supplementary formulae. Supplementary formula A was developed by using only these ingredients but supplementary formula B was made by using 50% of these ingredients along with roasted rice flakes and bengal gram flour. Table no 2,3 and 4 shows the detail composition of all three diets.

Table 2: Composition of Stock diet :

Ingredient	**Amount (per 100 g)**
Wheat flour (g)	53
Skimmed milk powder (g)	29
Roasted Bengal gram flour (g)	10
Wheat bran (g)	3
Ground nut oil (g)	5
Multivitamin drop (ml)	0.2

Table 3: Composition of Supplementary formula (per 100 g) :

Ingredient	**Supplementary formula A**	**Supplementary formula B**
Roasted Jackfruit seed powder (g)	65	22.5
Watermelon seed powder (g)	25	20
Drumstick leave powder (g)	5	5
Fish bone dust of Katla (g)	5	2.5
Rice flakes powder (g)	-	30
Roasted Bengal gram powder (g)	-	20

Table 4: Nutritive value of stock diet and supplementary formula(per 100 g)

Proximate composition	Stock diet	Supplementary formula A	Supplementary formula B
Energy (Kcal)	376.64	385.22	385.59
Carbohydrate (g)	59.24	55.22	55.77
Protein (g)	20.16	20.06	20.48
Fat (g)	6.56	9.34	8.95
Fiber (g)	2.39	5.43	5.15
Calcium (mg)	430.73	1820.30	1270.96
Iron (mg)	4.25	7.44	7.35

Data Collection: The rats were placed on the different experimental diets for 4 weeks during which period data were collected on the following and analyzed.
(i) Food intake (g): Food was given once daily for the rats of each group. Feed intake was determined as the difference between feed offered and feed left over on daily basis and average weekly feed intake was calculated from this value.
(ii) Body weight changes (g): Initial live weights of the rats were taken after the preliminary period at the beginning of the experiment and were subsequently weighed weekly throughout the 4 weeks period. The growth performance of the rats was determined by measuring live weight in 7 days interval and average daily weight gain was calculated.
(iii) Feed conversion ratio: Feed conservation efficiency (FCE) was determined as the ratio of feed consumed to body weight gain.
(iv) Protein efficiency ratio: Average protein intake was measured and protein efficiency ratio (PER) was also calculated by measuring weight gain per gm of protein intake.

Sample collection: All the rats were sacrificed on 29th day under light anesthetic ether. Animals were dissected and blood was taken by cardiac puncture of each rat. Serum was separated by usual methods. Liver of each rat was colected and weighed.

Biochemical parameters measured: For the evaluation of hepato-protective activity of stock and experimental diet, liver weight, serum glutamic oxaloacetate transe aminase (SGOT), serum glutamic Pyruvate transeaminase (SGPT) and Alkaline phosphatase (ALP) level were measured. Diagnostic kits were used for estimation of ALP, SGOT and SGPT. ALP was estimated by Kind and King's method [10]. SGOT and SGPT were analysed by Reitman and Frankol method[11].

Statistical Analysis of Results: Since the composition of SF A and SF B were different, results obtained from control group were compared separately with treated group A and B. Student t test was applied for statistical analysis[14].

III. Results and Discussion

The food consumption as well as total weight gain of control group was significantly higher compared to treated group A. .But no significant difference was found comparing the same between control group and treated group B. The daily food intake for treated group A recorded was only 7.82g whereas it was 9.97g and 10.03g for control group, treated group B. Treated group A gained only 6.66 gm of weight during the entire intervention period of 28 days whereas 32.77 gm and 30 gm of weight was increased for control group and treated group B respectively. Comparatively higher food intake might be the reason for greater weight gain for control group when compared with treated group A.

The mean FCE value obtained were 8.71, 21.9 and 9.76 for control, treated group A and B respectively. Therefore SF A found to have most poor FCE as it require 21.9 g of formula to gain 1g of weight whereas only 8.71g of stock diet was sufficient to gain same weight for albino rats. Treated group A required almost 2.5 times higher amount of food than control group to gain one gm of weight.

Comparing the data of growth pattern between control & treated group A were found to be highly significant ($p=<0.001$). But the difference was non significant while compared the values between control and treated group B.

Table 5: Growth pattern of experimental animals

Indicator	Control Group Mean ± SEM (n=9)	Treated Group A Mean ± SEM (n=9)	P Value
Mean initial weight (g)	94.44±1.5	95±1.44	NS
Mean final weight (g)	126.11±1.11	104.44±1.3	< 0.001
Mean total weight gain (g)	32.77±1.60	6.66±1.66	< 0.001
Mean daily weight gain (g)	1.16±0.06	0.23±0.05	< 0.001
Mean total food intake (g)	279.38±4.59	220.08±3.11	< 0.001
Mean daily food intake (g)	9.97±0.16	7.82±0.10	< 0.001
Feed conservation efficiency (FCE) (feed intake/gm weight gain)	8.71±0.50	21.9±0.42	< 0.001
Mean total protein intake (g)	56.09±0.92	44.14±0.62	< 0.001
Protein efficiency ratio (PER) (weight gain/gm protein intake)	0.57±0.03	0.14±0.036	< 0.001

NS- not-significant

Protein efficiency ratio (PER) is a parameter which is very helpful to evaluate the quality of protein present in food. Table no.5 and 6 shows the value of PER for control, treated A and B group are 0.57, 0.14 and 0.52 respectively. Similarly like FCE value, SF-A found to have very poor data for PER. Only 0.14 g of weight gain was possible by consuming a gm of protein present in SF-A. But for SF-B, 0.52 g of weight gain was attained from a gm of protein present in the formula which was more than 3 times of higher than SF-A. Highly significant difference (p=<0.001) was observed while compared the PER value of control & treated group A . But no significant difference was found comparing the obtained mean PER value between control and treated group B.

Table 6: Growth pattern of experimental animals

Indicator	Control Group Mean ± SEM (n=9)	Treated Group B Mean ± SEM (n=9)	P Value
Mean initial weight (g)	94.44±1.5	95±1.44	NS
Mean final weight (g)	126.11±1.11	125±1.66	NS
Mean total weight gain (g)	32.77±1.60	30±2.20	NS
Mean daily weight gain (g)	1.16±0.06	1.06±0.07	NS
Mean total food intake (g)	279.38±4.59	281.11±4.31	NS
Mean daily food intake (g)	9.97±0.16	10.03±0.15	NS
Feed conservation efficiency (FCE) (feed intake/gm weight gain)	8.71±0.50	9.76±0.72	NS
Mean total protein intake (g)	56.09±0.92	57.56±0.88	NS
Protein efficiency ratio (PER) (weight gain/gm protein intake)	0.57±0.03	0.52±0.04	NS

NS- not-significant

The liver weight and liver function test results are given in Table no. 7 and 8. The liver weight of control group , treated group A and B were 2.81,3.22 and 2.97 gm/100g of body weight respectively. No significant difference was found compraing the mean liver weight of experimental groups.

Serum glutamic oxaloacetic transaminase (SGOT) and Serum glutamic pyruvic transaminase (SGPT) are enzymes that are normally present in liver and heart cells. SGOT and SGPT are released in to blood when the liver or heart is damaged. Alkaline phosphatase (ALP) is enzyme made in the liver. Abnormally high values of ALP in blood may indicate disease in liver. Table no.7 and 8 shows treated groups were having slightly higher level of SGPT, SGOT and ALP than control group. However statistical analysis has shown that there was no significant difference (P=<0.05) among the values obtained from three groups.

Comparison of liver weight and liver function test:

Table 7: Liver weight and Liver function tests

Enzyme	Control Group	Treated Group A	P Value
Liver weight (g/100g body wt)	2.81±0.16	3.22±0.11	NS
SGPT (IU/L)	107.06±2.51	117.38±3.73	NS
SGOT (IU/L)	398.76±1.85	408.11±11.15	NS
ALP (KA Unit)	86.02±3.06	95.56±3.11	NS

NS- not-significant

Table 8: Liver weight and Liver function tests

Enzyme	Control Group	Treated Group B	P Value
Liver weight (g/100g body wt)	2.81±0.16	2.97±0.10	NS
SGPT (IU/L)	107.06±2.51	114.18±2.48	NS
SGOT (IU/L)	398.76±1.85	407.98±5.1	NS
ALP (KA Unit)	86.02±3.06	91.96±2.19	NS

NS- not-significant

Processing techique and proportion of using jackfruit seed powder in SF-A and SF-B made a huge difference in the growth preformance of albino rats. When severe growth retardation was recorded for treated group A , comparabe weight gain with the control group was noticed for treated group B. This finding is aline with the former study where severe depressed growth performance and increased mortality in chicks was reported by inclusion of 125g and 250 g of raw jackseed flour/kg diet by Ravindran et al.. The presence of lectin and trypsin inhibitors in raw jackseed was also reported causing the toxic effect on chicks[15]. Here in the present study after analyzing the obtained results it may be said that, though usage of higher proportion of dry heat treated jackfruit seed powder creat severe growth retardation in albino rats but it did not modified or altered liver enzyme activity indicating normal functioning of liver.

IV. Conclusion

Processing of jackfruit seed is very crucial to make it beneficial for body. Incorporation of dry heat treated jackfruit seed powder in higher proportion causes severe growth retardation in experimental animals. But usage of the powder in 22.5% level has been found to impart comparable growth with control group. Liver weight and liver function tests did not reveal any adverse effect in experimental animals. Therefore it can be said that small to moderate proportion of dry heat treated jackfruit seed powder can be used to develop any food products .

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