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In Vivo Study of Nutritive Value of Oil Seeds from New Varieties of Sunflower, Safflower and Groundnut

SHORT COMMUNICATION

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Abstract

The nutritive value of new varieties of oil seeds has been assessed in a series of feeding trial with 34 days old 18 white rats supported moderate rat growth (male albino). The nutritive values of five new varieties of oil seeds, viz sunflower (*Helianths annuus* L.) variety LSF -11 and LSF-8 , safflower (*Carthamus tinctorius* L.) variety PBNS-12 and PBNS-40, and groundnut (*Arachis hypogaea* L.) variety JL-24 were determined and compared in terms of the total feed intake, faeces voided, feed utilization, percent of feed utilization, nitrogen intake, nitrogen voided, nitrogen utilization, percent of nitrogen utilization, protein efficiency ratio and feed efficiency ratio per rat per day were reported in ranged between 6.56 to 8.03, 1.20 to 1.48, 5.26 to 6.55, 80.15 to 82.70, 0.25 to 0.32, 0.02 to 0.028, 0.23 to 0.30, 90.75 to 92.89, (+)1.37 to (+)1.51 and (+)0.35 to (+)0.37 percent respectively. These new varieties of oil seeds were found non-toxic for rats and supported moderate rat growth.

Keywords: *Nutritive value; oil seeds, Helianths annuus; Carthamus tinctorius; Arachis hypogaea; In vivo*

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INTRODUCTION

All living organisms need food for growth, work, repair and maintaining the life process. Oil seeds constitute one of the largest potential sources of protein in the world and play a vital in the Human diet (McKevith, 2005). The nutritional quality of a protein is determined by the amino acid composition and the digestibility of that protein. Biological assay measure the efficiency of biological utilization of dietary protein as source of the essential amino acid under a set of standard condition. A biological assay of the quality of a particular protein, measured as the gain in weight of an animal per gram of the protein taken. Recently, many methods have been developed for obtaining nutritive value by comparing protein efficiency ratio (PER), relative protein value (RPV), net protein ratio (NPR) and a modified protein efficiency ratio. Two methods are widely used in the determination of nutritive value, these are Growth methods (PER, NPR, RPV) and Nitrogen balance methods (Apparent digestibility (AD), true digestibility (TD), net protein utilization and biological value) (Hackler, 1977).

High nutritive value to oil seeds like groundnut is attributed to the presence of biologically active compounds such as, tocopherols, flavonoids, phytosterols, resveratrol, relatively high level of protein and their easy oil digestibility (Venkatachalam and Sathe, 2006; Tuberoso *et al.,* 2007). Recently, several attempts have been made to produce new cultivars with improved nutritional qualities (Jonnala *et al.,* 2005). A balanced diet is one which contains all the essential nutrients like carbohydrates, fats, proteins, minerals and vitamins in the correct proportion for the normal growth and development of the body (Babji *et al.,* 2010; Balsubramanian *et al.,* 1980). The protein Advisory Group (World Health Organization/Food Agricultural Organization/UNICEF) pointed out that in the selection of protein mixtures suitable for supplement diets, attention must be paid to factors such as, the nutritive value of the individual ingredients and the final product, avoiding the possibility of the presence of toxic or interfering substances which reduce the nutritive value, the desirability using products of local origin, low cost, good keeping qualities and acceptability (Joint FAO/WHO Expert Consultation, 2007; Arnold, 1980).

The main objective of this research is to investigate the nutritive value of sunflower variety LSF-11 and LSF-8, safflower variety PBNS-12 and PBNS-40 and groundnut variety JL-24. It will also provide knowledge on the nutritional implication of feeding on staples of low nutritive quality.

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MATERIALS AND METHODS

Sample Collection

The field experiment is conducted on sunflower variety LSF-11 and LSF-8, safflower variety PBNS-12 and PBNS-40 and groundnut variety JL-24. The seeds under investigation were procured from Oil Seeds Research Station, Latur (Maharashtra), Marathwada Agricultural University, Parbhani and Mahatma Phule Krishi Vidyapeeth, Jalgaon (Maharashtra).

Experimental Setup

The experiment was performed on the white male albino rats. Eighteen rats 34 days old were distributed in six groups of three rats, each selected rats were of body weight nearest to the mean of population. They were housed in individual cages. The rats were fed ad-libitum exclusively experimental diets for 10 days (Bressani *et al.*, 1977) including the three days of pre experimental period and water was available ad-libitum.

The experimental diets were isonitrogenious (24.50 g/100g) and isocaloric (3030 kcal/ kg of balanced diet). The balance diet (Table-1) comprised per kg:- 420 g maize yellow, 50 g oil, 430 g groundnut cake, 80 g fish meal (Jawala), 19.6 g mineral mixture and 0.49 vitamin mixture as recommended by Indian Standards Institution (565.4 part I 1970). Casein and seed proteins were added to this basal diet by substitution of the maize yellow to give a total dietary protein content of 100g/kg. The seed meals used in the study were autoclaved for 30 minutes at 15 1b pressure (Kaduskar and Netke, 1978) before being incorporated in the diets to destroy the toxic constituents (Cyanogenetic glycosides, tannin, trypsin inhibitors and haemagglutinins).

Table 1. Composition of experimental diet and balanced diet

Diet Ingredients	Balanced	Sunflower		Safflower		Groundnut
	Diet	LSF- 11	LSF- 8	PBNS- 12	PBNS- 40	JL-24
Maize Yellow	420	380	380	320	320	380
Fat	50	70	70	90	90	70
Groundnut Cake	430	400	400	410	410	400
Powder of sample	-	50	50	80	80	50
Fish Meal (Jawala)	80	80	80	80	80	80
Mineral mixture	19.6	19.6	19.6	19.6	19.6	19.6
Vitamin mixture	0.4	0.4	0.4	0.4	0.4	0.4
Metabolic energy	3053.10	3029.94	3028.03	3029.49	3030.86	3032.91
Calculated protein (%)	24.89	24.55	24.54	24.43	24.44	24.56
Analysed protein (%)	25.21	24.40	24.12	24.11	24.34	25.25

The animal testing work was approved by animal ethical committee at Department of Nutrition, College of Veterinary Sciences and Animal Husbandry, Jabalpur.

Analysis

The weight and food intake of the rats were monitored daily. Faeces were collected between days 5 to 10 days on the trial. The fecal matter (excreta) was dried in hot oven at 100°C. Protein efficiency ratio and feed efficiency ratio were calculated by the method given by (Osborne *et al.*, 1919). Total nitrogen intake and nitrogen voided were estimated by semi-micro Kjeldahl method (Person, 1973).

Statistical Analysis

Results of *H. annuus* variety LSF-11 and LSF-8 and *C. tinctorius* variety PBNS-12 and PBNS-40 were analyzed for statistical report by using 'student t test'. Descriptive statistics (Mean, standard error mean and standard deviation) were calculated for triplicate determination using the SPSS 10 computer software package and significant differences within treatments were determined using 5% significance level.

RESULTS AND DISCUSSIONS

In the present experiment feed intake denotes the food consumed in last three days. Feed intake, faces voided,

feed utilization, percentage of feed utilization, nitrogen utilization, nitrogen intake, nitrogen voided, nitrogen utilization and percentage of nitrogen utilization per rat per day are given in Table-2. Gain in body weight, total feed consumed, total protein consumed protein efficiency ratio and feed efficiency ratio per rat for 10 days are given in Table-3.

In the collection period of three days the total feed intake, faeces voided, feed utilization, percent of feed utilization, nitrogen intake, nitrogen voided, nitrogen utilization and percent of nitrogen utilization per rat per day were found to be in ranged between 6.56 to 8.03, 1.20 to 1.48, 5.26 to 6.55, 80.15 to 82.70, 0.25 to 0.32, 0.02 to 0.03, 0.23 to 0.30 and 90.75 to 92.89 percent respectively in the seeds of *H. annuus* variety LSF-11 and LSF-8, *C. tinctorius* variety PBNS-12 and PBNS-40 and *A. hypogaea* variety JL-24. Crude protein content and other proximate constituent are not affected by autoclaving (Gupta *et al.*, 1988) and protein digestibility is enhanced by four to forty percent as compared to raw material (Sangle *et al.*, 1993).

Table 2. Feed and nitrogen intake by experimental animal

Diet of selected samples	Feed intake (g)	Faeces voided (g)	Feed utilization (g)	Feed Utilization (%)	Nitrogen intake (g)	Nitrogen voided (g)	Nitrogen utilization (g)	Nitrogen Utilization (%)
Balanced Diet	7.87	1.62	6.52	79.41	0.32	0.03	0.28	89.37
Sunflower (LSF-11)	6.82	1.35	5.47	80.19	0.27	0.03	0.24	90.75
Sunflower (LSF-8)	6.56	1.30	5.26	80.15	0.25	0.02	0.23	91.50
Safflower (PBNS-12)	7.18	1.24	5.94	82.70	0.28	0.02	0.26	92.82
Safflower (PBNS-40)	6.92	1.20	5.72	82.66	0.27	0.02	0.25	92.89
Groundnut (JL-24)	8.03	1.48	6.55	81.61	0.32	0.028	0.30	91.27

Table 3. Gain in body weight, total protein consumed, protein efficiency ratio and feed efficiency ratio

Diet of selected samples	Protein in diet (%)	Gain in Body wt (g)	Total feed consumed (g)	Total protein consumed (%)	Protein efficiency ratio(PER) (%)	Feed efficiency ratio(FER) (%)
Balanced Diet	25.21	26.91	78.72	19.85	1.36	0.34
Sunflower (LSF-11)	24.40	24.49	68.16	16.63	1.47	0.36
Sunflower (LSF-8)	24.12	23.78	65.63	15.83	1.50	0.36
Safflower (PBNS-12)	24.11	26.13	71.84	17.32	1.51	0.36
Safflower (PBNS-40)	24.34	25.21	69.22	16.85	1.50	0.37
Groundnut (JL-24)	25.25	27.73	80.28	20.27	1.37	0.35

The feed utilization for *H. annuus* variety LSF-11 and LSF-8, *C. tinctorius* variety PBNS-12 and PBNS-40 and *A. hypogaea* variety JL-24 was found to be 5.47, 5.26, 5.94, 5.72 and 6.55g, respectively. However, nitrogen utilization for these varieties was found to be 0.24, 0.23, 0.26, 0.25 and 0.30g, respectively.

The value of feed utilization and nitrogen utilization of these varieties was found to be in close resemblance with the values of feed utilization (6.52g) and nitrogen utilization (0.28g) of controlled diet and also with other varieties of oil seeds (Gupta and Shrivastava, 2003; Nagraj, 1995; Singh *et al.*, 2000; Shrivastava *et al.*, 1991).

The gain in body weight, total feed consumed and total protein consumed for *H. annuus* variety LSF-11 and LSF-8, *C. tinctorius* variety PBNS-12 and PBNS-40 and *A. hypogaea* variety JL-24 were found to be in ranged

between 23.78 to 27.73, 65.63 to 80.28 and 15.83 to 20.27g, respectively.

The protein efficiency ratio of all the five varieties under study are in general accordance with one another i.e. 1.47 (LSF-11), 1.50 (LSF-8), 1.51 (PBNS-12), 1.50 (PBNS-40) and 1.37 (JL-24) and also with controlled diet 1.36. Also the feed efficiency ratio for *H. annuus* variety LSF-11 and LSF-8, *C. tinctorius* variety PBNS-12 and PBNS-40 and *A. hypogaea* variety JL-24 was found to be 0.36, 0.36, 0.36, 0.37 and 0.35, respectively. The value of feed efficiency ratio for there varieties was found to be in close resemblance with 0.34 of controlled diet, these five varieties under study showed almost same nutritive value in spite of having different chemical composition. It may be due to isonitrogeneous inclusion of crude protein of oil seeds (Shrivastava *et al.*, 1991; Gupta and Shrivastava, 2003).

Table 4 shows the statistical report of *H. annuus* varieties LSF-11 and LSF-8 indicating non-significant result with respect to all parameters. Similarly the statistical report of *C. tinctorius* varieties PBNS-12 and PBNS-40 indicating non-significant result with respect to all parameters except percent nitrogen utilization and feed efficiency ratio.

Table 4. Statistical analysis of diet samples of sunflower (LSF11 and LSF-8) and safflower (PBNS-12 and PBNS-40)

Experimental diet	Feed intake (g)	Faeces voided (g)	Feed utilization (g)	Feed utilization (%)	Nitrogen intake (g)	Nitrogen voided (g)	Nitrogen utilization (g)	Nitrogen Utilization (%)	Gain in body wt (g)	Total feed consumed (g)	Total protein consumed (%)	Protein efficiency ratio (%)	Feed efficiency ratio (%)
Sunflower (LSF-11)	6.82	1.35	5.47	80.19	0.27	0.03	0.24	90.75	24.49	68.16	16.63	1.47	0.36
Sunflower (LSF-8)	6.56	1.30	5.26	80.15	0.25	0.02	0.23	91.50	23.78	65.63	15.83	1.50	0.36
Mean	6.66	1.33	5.36	80.17	0.26	0.02	0.24	91.16	24.13	66.90	16.23	1.49	0.36
S.E.(m)	0.05	0.01	0.05	0.01	0.003	0.001	0.002	0.170	0.159	0.568	0.179	0.006	0.001
S.D.	0.13	0.03	0.113	0.023	0.01	0.01	0.010	0.42	0.39	1.39	0.44	0.02	0.00
S.L. at 5%	0.12*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Safflower (PBNS-12)	7.18	1.24	5.94	82.70	0.28	0.02	0.26	92.82	26.13	71.84	17.32	1.51	0.36
Safflower (PBNS-40)	6.92	1.20	5.72	82.66	0.27	0.02	0.25	92.89	25.21	69.22	16.85	1.50	0.37
Mean	7.05	1.22	5.83	82.68	0.27	0.19	0.25	92.88	25.67	70.53	17.09	1.50	0.36
S.E.(m)	0.06	0.01	0.05	0.010	0.00	0.00	0.00	0.02	0.21	0.59	0.10	0.00	0.00
S.D.	0.14	0.02	0.12	0.02	0.00	0.00	0.00	0.06	0.50	1.43	0.26	0.010	0.00
S.L. at 5%	0.00	0.010	0.00	0.00	0.00	0.00	0.00	0.14*	0.00	0.00	0.00	0.00	0.10*

S.E. (m) – Standard error mean, S.D. – Standard deviation, S.L at 5% - Significance level at 5% ,*Significan

CONCLUSION

Five new varieties of oil seeds were found non-toxic for rats. The results of the present nutritional studies with rats suggest that they could be more widely grown and utilized as dietary protein sources and these could be put to far greater use. Their potential for nutritional exploitation is further enhanced by the fact that they would not require prolonged and expensive heat-treatment prior to use. Similarly these seeds presently are being used in oil production and for human and animal feeding. Produce seeds of high N content and no

measurable toxicity and thus have good potential for development.

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