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APPARENT NUTRIENT DIGESTIBILITY COEFFICIENT OF SUNFLOWER AND SESAME SEED MEAL IN *Clarias gariepinus* (BURCHELL 1822) FINGERLINGS

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ABSTRACT

The apparent digestibility coefficient of raw sunflower (Helianthus annus). and sesame (Sesamum indicum) seedmeal by Clariid catfish (Clarias gariepinus) fingerlings was evaluated at 15,30 and 45% levels of replacement respectively using soybean meal based diets as control diet. There was significant difference (p<0.05) in apparent organic matter digestibility (AOM), apparent protein digestibility (APD), apparent energy digestibility (AED) apparent carbohydrate digestibility (ACD) between the fish fed control diet and the fish fed test diets. However there was no significant difference (p>0.05) in apparent lipid and fibre digestibilities of fish fed control diet and test diets RSF_{15} and RSM_{15}.

INTRODUCTION

Soybean meal has high protein content and the best protein quality among plant protein feedstuffs used in fish feeds (Davies et al; 1999). It has been reported to partially a totally replace fish meal in diets of many aquaculture species (Lovell 1988, Lim and Akiyama, 1992). However, wider utilization and availability of this conventional source for fish feed is limited by increasing demand for human consumption and by other animal feed industries (Siddhuraju and Becker, 2001). It then becomes a priority to look for cheaper, alternative protein source. Sunflower (*Helianthus annus* vr. *macrocarpus*) and sesame seed (*Sesamum indicum*) are important annual crops of the world grown for oil. They have nutrient density comparable to other oilseed proteins including soybean meal and other conventional legumes (Robertson and Russel, 1972, Jackson *et al*., 1982, Hossain and Jauncey, 1989a and b, Sanz *et al*., 1994, Sintayehu *et al*.,1996) and their potentials as dietary protein sources are well recognized. (Olvera – Novoa *et al*, 2002). Fagbenro *et al*.,2 003 then Jauncey (1993) reported that the most important characteristics of feedstuffs is the bioavailability of nutrients, hence reliable data on the different ingredients for each species need to be well considered as a necessary prerequisite. De Silva and Anderson, 1995 also observed that it is essential to have a knowledge of the digestibility of the main ingredients as well as of the whole diet in feed formulation and manufacture; Borghesi *et al*., 2008 reported that knowing nutrient digestibilities of feed ingredients elicit interchangeability of feed ingredients without reducing animal performance. In combination, chemical analysis and apparent digestibility coefficient (ADC) results allow us to precisely estimate not only the contribution of a particular protein source to a complete fish feed but also how much feed wastes and undigested nutrients (faeces) will potentially accumulate in fish pond. (Koprucu and Ozdemer, 2005). Hence an attempt has been to evaluate the possibility of incorporating raw sunflower and sesame seedmeal at different levels into the diets of *Clarias gariepinus* fingerlings by determining the digestibility coefficient of the nutrients in each diet with a view to bringing out the best level of incorporation of these ingredients.

MATERIALS AND METHODS

SOURCES AND PROCESSING OF INGREDIENTS

The dehulled seeds of sunflower and sesame were obtained from a farm in Kebbi State, Nigeria. They were ground in a hammer milled and the oil therein was removed using the pressure generated from locally made screw press (cassava-presser type). The cakes therefore were analysed for their proximate composition (AOAC 1990).Fish meal, soybean meal and other feedstuffs obtained from commercial sources in Nigeria were separately milled screened to fine particles size and triplicate samples were analyzed for their proximate composition (AOAC, 1990).Based on the nutrient composition of the protein feed stuff (Table 1), a control diet and six test diets (40% crude Protein, 12% crude Lipid, 18 MJ energy) were formulated. The control diets contained soybean meal, providing 50% of the total protein. Three of the test diets contained sunflower meal protein at a replacement levels of 15, 30 and 45% for the soybean meal to serve as test diets RSF_{15}, RSF_{30}, and RSF_{45} respectively while the other three contained sesame meal protein at the same replacement levels for the soybean meal to serve as test diets RSM_{15}, RSM_{30}, and RSM_{45} respectively (Table 2). The feedstuffs were blended, moistened, steam pelleted and oven dried for 24hrs.

CULTURE CONDITION

Clarias gariepinus fingerlings were acclimated to experimental condition for seven days prior to the feeding trial. Groups of 15 *Clarias* fingerlings, (3.28 ± 0.15g) were stocked into aquaria comprising 60 – litre capacity rectangular tanks. Each diet was fed to catfish in triplicate tanks twice daily (9 – 10hrs, 16 – 17hrs) at 5% body weight for 28 days. Faecal collection began 7 days after the feeding of experimental diets commenced. Collection of faecal samples was carried out for 21 days using a 2cm–pipe six hours after feeding. Uneaten diets were siphoned 90 minutes after feeding. Droppings from the same tanks were pooled together in a bowl and stored in a freezer. Water temperature and dissolved oxygen were measured using combined digital YSI dissolved oxygen meter (YSI model 57, Yellow Spring, Ohio) pH was monitored weekly using pH meter (Mettler Teledo – 320, Jenway UK)

Proximate Analyses

The proximate analyses of feed ingredients, diets and faeces for crude protein, crude fibre, crude lipid, fat and ash were carried out in triplicate using the methods described by the AOAC, (1990). A factor of 6.25 was used to convert nitrogen to protein. The nitrogen free extract was estimated by difference. Energy content of faeces and diets were determined using the physiological value of 5.6 Kcal/g protein, 4.1 Kcal/g carbohydrate and 9.5 Kcal/g Lipid.

AIA ANALYSES

AIA analyses were carried out on test diets and faeces using the methods described in Halver (1993), Adeparusi and Jimoh (2002).

DETERMINATION OF DIGESTIBILITY COEFFICIENT

This was calculated on the percentage of AIA in feed and in faeces and the percentage of nutrient on diets and feaces.

$$\text{Digestibility} = 100 - 100 \left(\frac{\text{AIA in feed}}{\text{AIA in faeces}} \times \frac{\text{Nutrient in faeces}}{\text{Nutrient in diets}} \right)$$

$$\text{Apparent Organic Matter Digestibility (AOMD)} = 100 - 100 \left(\frac{\text{AIA in feed}}{\text{AIA in faeces}} \right)$$

STATISTICAL ANALYSES

Results are expressed as mean ± SD. All data were subjected to one way ANOVA using SPSS 13.0 for window software. Where significant differences occurred, the group means were further compared with Duncan's multiple range test using SPSS 13.0 (SPSS, IL, USA).

RESULTS AND DISCUSSION

Table 2 showed the proximate composition of soybean meal, sunflower meal, sesame meal, corn and fish meal. Table 3 showed the proximate composition of the experimental diet; it revealed the diets to be isonitrogenous as there was no significant difference (P > 0.05) in the protein content of the diets. Fish in different dietary groups fed actively on the experimental diets throughout the experiments. The AIA in diet CTR was significantly lower (P<0.05) than the test diets. There was no significant difference (P>0.05) in the AIA of the test diets. The highest AIA in faeces was recorded in the faecal samples of fish fed diet RSM_{15} while the lowest was recorded in the faecal samples of fish fed diet RSM_{15}. Significant variation ((P<0.05) was recorded among the AIA of fish fed control diets and test diets but the variation lack definite pattern that is, it is not related to the level of inclusion of the seed meal. Table 4 showed the proximate composition of faecal samples of fish fed control and test diets. There was no significant difference ((P> 0.05) in the protein content of the faecal samples of fish fed diet CTR, RSF_{15} and RSF_{30}. Similarly there was no significant difference (P>0.05) in the protein content of the faecal samples of fish fed RSM_{15} and RSM_{15}, RSM_{30}. The crude lipid content of the faecal samples of fish fed diet CTR was not significantly different (P>0.05) from that of fish fed diet RSF_{15}, $RSF_{30,}$ RSF_{45}, RSF_{45}, RSM_{30}, RSM_{45}. There was significant difference ((P<0.05) in the crude fibre content of fish fed diet CTR and fish fed other test diets. However there was no significant difference (P>0.05) in the crude fibre content of fish fed diet CTR and fish fed other test diets. However there was no significant difference (P>0.05) in the crude fibre content of the faecal samples of fish fed test diets. Table 5 presents apparent digestibility coefficient of nutrients in raw sunflower and sesame meal based diets fed to *Clarias gariepinus* fingerlings. A significant variation (P<0.05) exists among the fish fed control diet and test diets with respect to AOMD, APD, AED, ACD. There was no significant difference (P>0.05) in AFD and ALD of the fish fed diet CTR and diets RSF_{15} and $RSM_{15.}$

The apparent digestibility coefficient for organic matter, protein, energy, lipid, fibre, carbohydrate of control diets were highest in comparison to those found raw sunflower and sesame seed meal incorporated diets. The value is in agreement with the values reported for carp (Smith *et al.*, 1980, Hossain and Jauncey 1989, Muckhopadyay, 2001). The values of apparent digestibility of protein and lipid for the control diet obtained during the experiment were almost similar to those obtained by Hossain and Jauncey 1989, Muckopadyay, 2001. The values of apparent digestibility of protein and lipid of the test diets containing raw sesame seedmeal were comparable to those found by Hassan (1986) in common carp fry diets containing different proportions of mustard, Linseed and sesame seed meals. Hossain and Jauncey (1989), Muckopadhyay (2001) found similar result in *Cyprinus carpio* diets containing graded level of raw sesame seed meal. There was significant reduction in apparent digestibility of nutrients with increasing level of inclusion of sunflower and sesame seed meal; a similar observation were made by Muckopadlyay (2001), Hossain and Jauncey 1989. The little variation of their results with this under study could be attributed to variability of nutrients as well as differences in nutrient processing experimental methodology and faeces sampling technique (Jauncey, 1993). The lower digestibility coefficient recorded for crude fibre and carbohydrate in *Clarias* fed control diets and test diets might not be unconnected to the physiological requirement of *Clarias gariepinus*. It is a carnivorous fish. The low carbohydrate digestibility recorded in this study was similar to that reported by Adeparusi and Jimoh (2002) for *Oreochromis niloticus* fed lima bean. The digestibility of carbohydrate has been to vary with their complexibility of carbohydrate has been to vary with their complexibility, source treatment and level of inclusion in the diet (Phillip, 1972), Lovell, 1977, Cho and Slinger, 1979). The organic matter digestibility coefficient reported in this study was slightly higher than the value reported by Fagbenro,1998 the variation may be attributed to processing methods, and or the variation may be attributed to processing methods, and or experimental methodology; different seed meal and fish species was used as it is known that digestibility of nutrients are species specific however the result closely related to that reported in Martinez – palacois *et al.*, 1988 and Yue and Zhou, 2008 for juvenile hybrid tilapia fed cottonseed meal. No significant variation ($P<0.05$) occurred in lipid digestibility by *Clarias gariepinus* fed diets CTR, $RSM_{15}$and RSF_{15}. Although the lipid digestibility of the fish fed other test diets was so high. The result was in conjunction with what was reported by Hossain *et al*, 1992 for rainbow trout range of 76 to 97% feet digestibility of various sources of fat had been reported for channel catfish (Lovell, 1977), Andrew *et al (*1978) reported that the ability to digest fat appears to be influenced by temperature and the level of fat in the diet. Sunflower and sesame oil has excellent nutritional properties. They are practically free of toxic composition. The high proportion of PUFA renders sunflower oil as a popular source of essential fatty acids in the diet (Lanstraat and Jurgens, 1976).Lower apparent protein digestibility recorded in this study was not in line in what was reported in Olivera- Novoa *et al.*, 2002 who fed the same seed meal to O. *niloltcus* and the study of Stickney *et al.*, (1996) which found that apparent protein digestibility of sunflower was similar or slightly lower than the apparent protein digestibility of fishmeal. Lall (1991) reported that digestibility data are useful only when ingredients do not contain anti-nutritional factors that may influence the digestibility of various nutrients in the diets and give erronous result. The raw sunflower and sesame seed meal without doubt contain same levels of anti-nutrients.Tacon 1992, and 1997 reported that sunflower contains protease inhibitors, saponins, tannin, Arginase inhibitor while sesame is reported to contain high amount of phytase. The lower apparent digestibility coefficient by *Clarias gariepinus* fed diets containing those ingredients might not be unconnected to negative effect imparted by the anti-metabolite present in them. Hence, research could be focused in processing technique that could be applied to these ingredients such that these anti-metabolites might be removed and their nutritive potential evaluated in fish feed.

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Table 1: Proximate Composition of Carcass of Protein Feed Ingredients

	Fishmeal	Soybean Meal	Sunflower Meal	Sesame Meal	Corn Meal
Moisture	7.59	8.92	9.48	8.39	9.21
Crude Protein	69.76	42.81	40.01	42.21	8.89
Crude Lipid	8.82	18.56	20.28	15.92	1.49
Crude Fibre	-	5.63	12.80	5.48	29.78
Ash	13,83	6.01	5.89	7.27	3.81
NFE	-	18.07	11.54	20.73	46.82

Table 2: Gross Composition (G/100g Dry Matter) of Experimental Diets Fed to *Clarias gariepinus* at Varying Replacement Levels of Raw Samples of Sunflower and Sesame seed meal Based Diets

	CTR	RSF_{15}	RSF_{30}	RSF_{45}	RSM_{15}	RSM_{30}	RSM_{45}
Fishmeal	27.24	27.24	27.24	27.24	27.24	27.24	27.24
Soybean meal	46.71	39.71	32.70	25.70	39.71	32.70	25.70
Raw samples	-	7.48	14.96	22.44	7.08	14.16	21.25
Corn meal	11.25	11.25	11.25	11.25	11.25	11.25	11.25
Fish oil	5.09	5.09	5.09	5.09	5.09	5.09	5.09
Vita/Min Premix	5.00	5	5	5	5	5	5
Starch	4.76	4.22	3.76	3.28	4.63	4.26	4.17
Total	100	100	100	100	100	100	100

Table 3: Proximate Composition (G/100g Dry Matter) of Experimental Diets Fed to *Clarias gariepinus* At Varying Replacement Levels of Raw Samples of Sunflower and Sesame seed meal Based Diets

	CTR	RSF_{15}	RSF_{30}	RSF_{45}	RSM_{15}	RSM_{30}	RSM_{45}
Moisture	9.17 ± .15^{b}	9.67 ± .72^{a}	9.36 ± .46^{ab}	9.57 ± .09^{ab}	9.39 ± .19^{ab}	9.43 ± .26^{ab}	9.37 ± .15^{ab}
Crude protein	40.60 ± .72	40.47 ± .46	40.28 ± .87	40.18 ± .28	40.48 ± .61	40.42 ± .36	40.24 ± .38
Crude lipid	11.74 ± .04^{c}	12.18 ± .12^{ab}	12.28 ± .05^{a}	12.32 ± .05^{a}	11.93 ±.12 ^{bc}	12.33 ± .06 ^{a}	12.46 ± .35 ^{a}
Crude fibre	5.84 ± .10 ^{b}	5.84 ± .08 ^{b}	6.44 ± .29 ^{a}	6.44 ± .28 ^{a}	5.53 ± .28 ^{b}	5.90 ± .04 ^{b}	5.87 ± .22 ^{b}
Ash	9.35 ± .10 ^{a}	8.71 ± .24^{bc}	8.80 ± .11^{bc}	9.04 ± .47^{ab}	8.91 ± .13^{abc}	8.81 ± .11^{bc}	8.51 ± .27 ^{c}
NFE	23.13 ± .74	23.42 ± .39	23.05 ± .75	22.46 ± .13	23.76 ± .93	22.92 ± .26	23.55 ± .94
Energy	4.31± .02^{d}	4.34 ± .01^{bc}	4.34 ± .02	4.32 ± .01 ^{cd}	4.35 ± .01^{ab}	4.35 ± .02 ^{b}	4.37 ± .01 ^{a}
AIA	.62 ± .02	.74 ± .02 ^{b}	.74 ± .01^{b}	.75 ± .03 ^{b}	.74 ± .03^{b}	.75 ± .03 ^{b}	.74 ±.02 ^{b}

Figures in each row with different superscript are significantly different (P<0.05) from each other

Table 4: Proximate Composition (G/100g Dry Matter) of Faecal Samples Fed to *Clarias gariepinus* at Varying Replacement Levels of Raw Samples of Sunflower and Sesame seed meal Based Diets

	CTR	RSF_{15}	RSF_{30}	RSF_{45}	RSM_{15}	RSM_{30}	RSM_{45}
Moisture	9.54 ± .25	9.77 ± .58	9.83 ± .22	9.45 ± .41	9.99 ± .29	9.61 ± .61	9.40 ± .07
Crude protein	15.80 ± .18^{d}	15.39 ± .18de	15.46 ± .08de	18.14 ± .31^{b}	15.22 ± .15^{e}	16.69 ± .39^{c}	19.43 ± .50^{a}
Crude lipid	6.46 ± .12^{a}	6.12 ± .23^{ab}	6.24 ± .28^{a}	6.09 ± .16^{ab}	5.84 ± .10^{b}	6.09 ± .20^{ab}	6.11 ± .22^{ab}
Crude fibre	12.6 ± .47^{a}	11.09 ± .24^{b}	10.57 ± .26^{b}	10.78 ± .29^{b}	10.61 ± .32^{b}	10.61 ± .32^{b}	10.71 ± .17^{b}
Ash	5.39 ± .21^{a}	5.44 ± .25^{a}	4.91 ±.10^{b}	4.58 ± .26^{bc}	5.33 ± .14^{a}	4.48 ± .27^{c}	4.64 ± .27^{bc}
NFE	50.23 ± .45^{c}	52.18 ± .63^{a}	52.99 ± .23^{a}	50.92 ± .69^{bc}	51.80 ± 1.38^{ab}	52.76 ± .22^{a}	49.88 ± .23^{c}
Energy	3.53 ± .12^{d}	3.57± .05^{cd}	3.62 ± .03^{bc}	3.67 ± .03^{ab}	3.56 ± .01^{cd}	3.66 ± .03^{ab}	3.71 ± .06^{a}
AIA	2.78 ± .06^{b}	2.79 ± .05^{ab}	2.49 ± .02^{d}	2.38 ± .04^{e}	2.86 ± .06^{a}	2.67 ± .06^{c}	2.46 ± .01^{d}

Figures in each row with different superscript are significantly different (P<0.05) from each other

Table 5: Apparent Digestibility Coefficient of Nutrients of Raw Sunflower and Sesame Meal Based Diets Fed to *Clarias gariepinus*

	CTR	RSF_{15}	RSF_{30}	RSF_{45}	RSM_{15}	RSM_{30}	RSM_{45}
Apparent Organic Matter Digestibility(AOMD)	77.55 ± .52^{a}	73.37 ± .69^{bc}	70.27 ± .17^{c}	68.36 ± 1.39^{e}	74.17 ± 1.24^{b}	71.90 ± .74^{c}	69.79 ± .72de
Apparent Protein Digestibility(APD)	91.26 ± .41^{a}	89.8 ± .37^{bc}	88.59 ± .26^{d}	85.71 ± .49^{e}	90.27 ± .58^{b}	88.99 ± .65^{cd}	89.40 ± .53 ^{e}
Apparent Energy Digestibility (AED	81.63 ± .52^{a}	78.12 ± .82^{b}	75.26 ± .13^{cd}	73.10 ± .99^{e}	78.75 ± .93^{b}	76.32 ± .69^{c}	74.50 ± .77^{d}
Apparent Lipid Digestibility (ALD)	87.65 ± .23^{a}	86.64 ± .37^{ab}	84.88 ± .56^{cd}	84.33 ± 1.03^{d}	87.32 ± .93^{ab}	86.11 ± .76^{bc}	85.19 ± .43^{cd}
Apparent Fibre Digestibility (AFD)	52.15 ± .88^{a}	50.20 ± 1.75^{ab}	49.69 ± 1.90^{bc}	46.80 ± 5.51^{bc}	50.39 ± 1.36^{ab}	49.40 ± 2.37^{bc}	44.83 ± 2.23^{c}
Apparent Carbohydrate Digestibility (ACD)	51.86 ± 1.19^{a}	40.67 ± 2.75^{b}	31.62 ± 2.31^{de}	28.20 ± 1.87^{e}	42.36 ± 2.73^{b}	35.29 ± 1.52^{cd}	36.12± 3.66^{c}

Figures in each row with different superscript are significantly different (P<0.05) from each other