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Effects of Substituting Safflower (*Carthamus tinctorius*) Meal with Soya Bean Meal on the Performance of SASSO X RIR Crossbred Chicken

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Abstract

This experiment was carried out to evaluate the nutritive value of safflower (Carthamus tinctorius) meal with the substituting of soybean grain on the performance of SASSO x RIR crossbred chicks. A total of one hundred fifty six 21 day-old male SASSO x RIR crossbred chicks were grouped into 12 pens of 13 chicks each, and randomly assigned to four dietary treatments with the first treatment T1 comprised a ration with no safflower meal (100% SBM), while T2, T3, and T4 were made to contain 20%, 40% and 60% safflower meal with substituting for soybean meal out of 36.35% of total mixed ration (TMR), respectively. All diets were isocaloric (3695.74 kcalME/kg DM) and isonitrogenous (21.42% CP). Feed intake, feed utilization efficiency and growth performance were determined from 2 to 12 weeks. The results showed that the mean dry matter intake and feed conversion efficiency were varying significantly ($P<0.05$) among the dietary treatments. Moreover, significantly ($P<0.01$) inferior final body weight gain was obtained in chicks fed 100% safflower meal than the rest of dietary treatments. Weight gain was highest (18.17 g/day) for the ration containing 21.8% safflower meal (60% substitute T4) and lowest (13.9 g/day) for the diet containing 36.35% soybean meal (control T1). The higher net return was detected in T4 (81.87 ETB) as compared to other treatments and the least return T1 (64.08 ETB). Based on this, it could be concluded that soybean grain could be substituted by safflower meal in chick's rations at the level of 60% without any adverse effect on the performance of chicks so as to increase the economic efficiency.

Keywords: Crossbred chicks; Growth performance; Safflower meal; Soybean meal; Substituting

Introduction

In poultry farming, feed remain the major challenge especially in Sub-Saharan Africa where the price of the conventional feed resources increase constantly. In addition, village chickens faced quantitative and qualitative feed shortage particularly in poor agricultural or household residues environment [1]. Because of the rising cost of common protein ingredient (groundnut cake, soybean and fish meal), stakeholders have little access to such resources.

Soybean meal is the most extensively used protein source in poultry diets as it has a high protein content, excellent balanced amino acid profile, high protein and amino acid digestibility, and palatability [2]. However, inconsistent supply, greater demand, and increasing costs have encouraged the search for a substitute [3]. Thus, the researchers used other protein sources which could have possibility to replace costly soybean meal in chicken diets [4]. According to Shi et al. [5] soybean meal, as the primary and most dependable protein source for poultry feed, is becoming progressively expensive; therefore, there is a need to look for alternative economical, easily available and quality protein sources.

Safflower is an annual broadleaf oil-seed crop whose seed contains between 25 and 45% oil [6]. The climate of North- East Dry Land areas of Amhara National Regional State in Ethiopia is suitable for safflower cultivation where it provides acceptable agronomic and economic returns to farmers similar to other sustainable rain-fed field crops.

Among other protein sources, the safflower meal (SM) which is obtained after oil extraction from the seed, has a good potential to be used in poultry feed [7]. The nutrient composition of the meal depends heavily on the properties of the seed and different processing condition during the extraction procedure. A complete dehulled seed results in a meal with about 60% crude protein but is very difficult to remove hulls from the seed because of its hard structure [8]. Safflower meal (solvent extracted) contains dry matter 90%, crude protein 22%, crude fiber 37%, oil 0.5% and ash 5% [9]. The objective of the current study was to evaluate the performance of SASSO x RIR crossbred chicks and to determine the economic viability when soybean grain is substituted by different levels of safflower meal.

Materials and Methods

Study area

The study was conducted in Ethiopia within Amhara National Regional State North Wollo administrative zone at Lasta district which is located at 120 19' N latitudes and 380 51' E longitudes at an altitude of 2520 m.a.s.l and 700 km far from Addis Ababa. The mean annual rainfall and temperature of the area amounts to 750 mm and 210, respectively. The study district has highland, midland and lowland agro ecologies.

Experimental animals and their management

The experiment was carried out in a dip litter poultry house with a soil compacted floor and corrugated iron sheets roof. The house was cleaned and disinfected and it was bedded with saw dust before the placement of the experimental birds to each pen. Waterers, feeders and infrared lamps were arranged in each pen before the arrival of

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the chicks. Natural and artificial light was maintained for 18 hours. A total of 156 male dual purpose crossbred chicks (SASSO X RIR) were purchased from MekelleEthio chicken Farms plc. The day-old chicks were brooded for two weeks in the house fed with commercial starter ration as an adaptation period. Thirteen (13) chicks were placed per pen with a dimension of 1.5 × 1.5 m. The birds were randomly distributed into four dietary treatments having 39 birds each. The chicks were vaccinated with live vaccine against Gumburo disease at the first day and against Newcastle Disease (HB1) at the seventh day and at 21st day through drinking. The birds were watered and fed the experimental concentrate diets from day 15 to 90. Feed intake and body weight were recorded daily and weekly respectively, using sensitive balance (Table 1).

Ingredients and experimental rations

The feed ingredients which were used in the formulation of the different experimental rations of the present study were corn grain, wheat short, soybean meal, safflower meal, noug seed cake, minerals and vitamins. Corn grain and wheat short were purchased from local markets and mill factories respectively. Soybean meal, noug seed cake and minerals were purchased from Bahir Dar. Safflower meal was prepared by collecting residue from the local oil processers and it was dried in partially shaded sun light using plastic sheet in order to protect from contamination. The proportions of each ingredient used to formulate the ration were based on NRC recommendation.

Experimental design and dietary treatment

The chickens were assigned to four dietary treatments in a completely randomized design (CRD). The four treatment rations used in this study were formulated substituting safflower meal with soybean meal at 0%, 20%, 40% & 60% levels in the total mixed ration. All the treatment rations were iso-caloric (3695.74 kcalME/kg DM) and iso-nitrogenous (21.42% CP). Feed and water were provided on ad libitum basis. Feed intake and refusals were weighed and recorded every day to estimate the feed consumption for each replicate and treatment. The chicks were also weighed individually at the beginning and subsequently every 7 days during the experimental period and at the end of 12 weeks by sensitive balance.

Laboratory analysis

Representative samples were taken from each of the feed ingredients used in the experiment and analysed before formulating the actual dietary treatments at DebreZeit National Veterinary Institute in the Nutrition and Biochemistry Laboratory. Feed samples were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash by employing the procedure of proximate analysis method [10]. The metabolizable energy (ME) levels of feed ingredients were calculated using the formula:

Ingredients	T1	T2	T3	T4
Maize	49.75	48.62	49.57	48.5
Soybean Meal	36.35	29.08	21.81	14.5
Safflower Meal	0	7.27	14.52	21.8
Wheat Short	9.4	10.2	10.1	10.7
Noug Seed Cake	3.6	3.93	3.1	3.6
Vitamin Premix	0.25	0.25	0.25	0.25
Toxin Binder	0.1	0.1	0.1	0.1
Limestone	0.1	0.1	0.1	0.1
Salt	0.45	0.45	0.45	0.45
Total	100	100	100	100
Calculated analysis				
Crud Protein (CP%)	20.75	21.65	21.85	21.45
ME Kcal/Kg/DM	3639.95	3668.51	3720.25	3754.25
T1=100% SBM: 0% SFM; T2=80% SBM: 20% SFM; T3= 60% SBM: 40% SFM; T4=40% SBM: 60% SFM.				

Table 1: Proportion of feed ingredients used in formulating the experimental ration (% DM base).

ME (kcal/kg DM)=3951+54.4 EE-88.7 CF-40.8 Ash [11].

Measurements and observations

Feed intake of each replicate was recorded daily throughout the experimental period. Individual weight of chicks for each replicates was taken once per week. The body weight measurements were used to determine pen averages and to calculate the feed conversion efficiency. The average feed intake was recorded (g/day). Feed conversion efficiency was calculated as gram feed intake /per gram body weight gain. Body weight gain was calculated by subtraction of the live body weight at the beginning of the week from that of the second measuring date (BWG, g/d). Feed cost per live weight gain was computed by the cost of feed consumed to attain a kilogram (kg) live weight gain.

Statiscal analysis

Collected data were statistically analyzed by one way ANOVA procedure using Statistical Analysis System (SAS university edition, version 9.4). When the analysis of variance indicated the existence of significant difference among treatment means, Tukey test was employed to test and locate the treatment means that are significantly different from each other. The significant difference was established when the level of significant is less than 0.05. The GLM (General linear model) procedure was fitted for Statistical analysis as follow;

$Yij=\mu+Ti+\varepsilon ijk$;

Where: Yij=response variable;

μ=over all means;

Ti=treatment effect;

Eijk=random error.

Partial budget analysis

A simple partial budget analysis was conducted as recommended by Upton [12]. The total return (TR) was determined by the difference between the selling and purchase price of the birds. The selling price of the birds was decided by persons who have related activity with this. Net income (NI) was calculated as the amount of money left when total variable costs (TVC) which includes the cost of feed materials subtracted from the total returns (TR). Feed cost of the ingredients was fixed based on the local market condition that found in the district.

NI= TR-TVC

The change in net income (ΔNI) was calculated as the difference between change in total return (ΔTR) and the change in total variable costs (ΔTVC). The change in net return (ΔNR) was calculated by the difference between the change in total return (ΔTR) and the change in total variable cost (ΔTVC), which was used as a reference criterion for decision on the adoption of the new technology.

ΔNR=ΔTR-ΔTVC

The marginal rate of return (MRR) measures the increase in net income (ΔNR) associated with each additional unit of expenditure (ΔTVC). This is expressed in percentage as:

MRR%=(ΔNR/ΔTVC) × 100. Therefore, the result was positive when the value of MRR after computing is greater than 1.

Results and Discussion

Chemical analysis

The chemical composition of the main ingredients used to compound the experimental rations and experimental diets are given in Tables 2 and 3, respectively. The DM content of safflower meal (SFM) in the present study was similar to Mahdi et al. [13] as he reported 94.4%, but higher than Voicu et al. [14] as they reported 91.5% DM. The crude protein content in soya bean is almost similar to that of safflower meal. The CP content of the SFM in the current finding was higher than 24% and 26.8% CP as reported by Mahdi et al. [13] and Voicu et al. [14], respectively but less than 51.5% CP as reported by Amponash et al. [15]. The safflower meal had more than twice the content of ether extract than soya bean. The EE content of SFM was comparable with that reported by Voicu et al. [14]. CF content of SFM in the present study was lower than Chapman et al. [16] as they reported (32.15%). The metabolizable energy of SFM used in the present study was higher than Amponash et al., [15] Shi et al. [5] and Mahdi et al. [13] as they reported 2416.06 and 2674.02 kcal/ kg DM, respectively but slightly comparable with 3348.42 kcal /kg DM as reported by Voicu et al. [14]. The differences in the chemical composition between safflower meal and soybean meal are also reflected in the chemical composition of the ration particularly the ether extract content in the diets was observed rising as the levels of inclusion of safflower meal increased. Variations in nutritive value of SFM in different studies obviously depend on different factors such as cultivars, growing environment, post-harvest handling and methods of processing (Tables 2 and 3).

The total protein content of soybean meal and safflower meal most likely seemed to be good protein sources feed ingredient for poultry, which agrees with Defang et al. [17].

Dry matter and nutrient intake

The mean daily dry matter intake (DMI) and nutrient intake (NI) of the total mixed ration is presented in Table 4. The daily DMI of the

S/No	Ingredients	DM	CP	EE	CF	ASH	ME Kcal/Kg/DM
1	Maize	88	7.53	3	4.67	4	3536.77
2	Soybean meal	96	43.81	12.37	6	4.5	3908.13
3	Safflower meal	95	44.86	21.54	5	6	4433.93
4	Wheat short	90	12.45	1.09	3.33	3	3591.97
5	Noug seed cake	91	29.4	8.16	20	7.5	2314.9

DM: Dry Mater; CP: Crude Protein; EE: Ether Extract; CF: Crude Fiber; ME: Metabolized Energy

Table 2: Chemical composition of ingredients used in formulation of dietary treatment ration (DM base).

Chemical Composition								
Treatment		DM	CP	CF	EE	ASH	NFE	ME(Kcal/kgDM)
Offered	T1	92.1	20.75	5.5	6.4	4.2	54.1	3639.95
	T2	92	21.65	5.5	7	4.3	53.1	3668.51
	T3	92	21.85	5.3	7.7	4.4	52.6	3720.25
	T4	91.9	21.45	5.3	8.4	4.5	51.5	3754.25
Ort	T1	87.3	19.94	6.14	5.14	4.82	51.26	3489.34
	T2	87.42	20.89	7.79	6.13	5.11	46.48	3385.01
	T3	87.2	20.25	5.59	5.76	4.9	50.7	3568.59
	T4	87.1	20.49	6.24	6.28	5.7	47.39	3506.58

DM: Dry Mater; CP: Crude Protein; EE: Ether Extract; CF: Crude Fiber; NFE: Nitrogen free extract; ME: Metabolized Energy; T: Treatment, T1: Basal Diet+100% Soybean Meal,+0% Treated Safflower Meal; T2: Basal Diet+80% Soybean Meal+20% Treated Safflower Meal; T3: Basal Diet+60% Soybean Meal+40% Treated Safflower Meal; T4: Basal Diet+40% Soybean Meal+60% Treated Safflower Meal

Table 3: The chemical compositions of feed offered and left over (DM base).

Parameter	T1	T2	T3	T4	Mean	MSE	Sign	CV
TDMI (g)	7680^{b}	7866.3^{b}	8572.7^{a}	8761.7^{a}	8220.1	286.1	*	3.48
DDMI(g/day)	85.33^{b}	87.4^{b}	95.25^{a}	97.35^{a}	91.33	3.18	*	3.49
CGI g/day/bid	42.83^{b}	42.88^{b}	47.6^{a}	47.6^{a}	45.25	1.54	**	3.4
SBMI g/day/bid	31.3^{a}	25.64^{b}	20.96^{c}	14.2^{d}	23.3	0.85	***	3.7
SFMI g/day/bid	0.00^{d}	6.41^{c}	13.95^{b}	21.4^{a}	10.44	0.38	***	3.6
NSCI g/day/bid	2.97^{b}	3^{b}	3.46^{a}	3.5^{a}	3.26	0.3	***	3.1
WSI g/day/bid	8^{d}	8.9^{c}	9.7^{b}	10.51^{a}	9.3	0.1	***	3.3
CP Intake	16.9^{c}	18.9^{b}	19.13^{b}	20.23^{a}	18.9	0.63	***	3.3
CF Intake	5.2^{c}	6.7^{a}	5.2^{c}	6^{b}	5.8	0.18	***	3.1
EE Intake	4.09^{c}	$4.3b^{c}$	4.6^{b}	5.4^{a}	5.2	0.17	*	3.2
Ash intake	4.09^{c}	$4.3b^{c}$	4.6^{b}	5.4^{a}	4.6	0.15	*	3.3
ME(Kcal/kgDM)	3560.48	3464.1	3595.84	3524.8				

^{a,b,c,d}Means with different superscripts in a row are significantly different at P<0.05.
SBM: Soybean Meal; SFM: Safflower Meal; NSC: Noug Seed Cake; WS: Wheat Short; ME: Metabolized Energy; CP: Crude Protein; CF: Crude Fiber; TDMI: Total Dry Mater Intake; DDMI: Daily Dry Mater Intake; CGI: Corn Grain Intake; SBMI: Soybean Meal Intake; SFMI: Safflower Meal Intake; NSCI: Noug Seed Cake Intake; WSI: Wheat Short Intake
*(P<0.05); highly significant at **(P<0.01); highly significance at ***(P<0.001)

Table 4: Dry matter and nutrient intake of SASSO X RIR crossbreed chicks fed ration during experimental period (12 weeks age).

chicks in this study was about 91.33 g/day, which was comparable with the results of Patwardhan et al. [18] who reported average daily feed intake of 92.79 ± 3.81 g up to 102 ± 3.81 g DM when safflower meal supplemented with other corn and tomato pomace. This might be due to the effective treatment of safflower meal on both trials. But our value is contradicted to the finding of Daffa et al. [19] who reported mean daily feed intake (65.77 g per day). There was a significant difference ($P<0.05$) among (T1, T2) and (T3, T4) in total DM intake. The higher mean daily feed intake per bird was recorded in T3 (95.25 ± 3.18) and T4 (97.35 ± 3.18) than the other treatments. The difference in dry mater intake of this study might be due to the increasing substitution level of safflower meal for soybean meal and this result agreed with Mahdi et al. [13]

Similarly Bryan et al. [20] Eila et al. [21] and Sisay et al. [22] reported daily feed intake as 127.53; 142.69 and 141.22 g, respectively, for birds fed with increasing substitution level of SFM. In addition, Mahdi et al. [13] reported average feed intake of birds as136.45 g per day in using industrially processed safflower meal which was higher than the current finding. This might be due to the breed difference; way of processing and other environmental factors. Higher feed intake at high level of safflower meal replacement could be an indicator that feed intake cannot be hampered by the anti-nutritional factor with treated feed through various dehulling processes [23]. Farran et al. [24] showed that crude fiber content of safflower meal can be minimized up to 5.47% by dehulling which makes good sources of protein for poultry and can increase the daily feed intake averagely from 149.23 up to 153.55 g per day (Table 4).

The daily nutrient intake of SASSO X RIR crossbred chicks during the experimental period was indicated in Table 4. The result showed that mean daily CP, EE and CF intake of all treatments were significantly different ($P<0.001$). This result agrees with finding of Patwardhan et al. [18], which they noted when we increase the substitution level of safflower meal with other feed ingredients the nutrient intake varies and improves. This variation in nutrient intake might be due to the reason that the chickens' nutrient intake increases as the substitution level increases.

This figure showed that weekly feed intake trend for entire experimental period and it can be make clear that there was increasing weekly feed intake as the substitution level of safflower meal in the diet increases. Especially the trend was slightly higher escalating rate for T4 and T3 than the other treatments T1 and T2, finally the feed intake increasing rate was slightly declined at the end of experimental period which may be due to increasing age of chickens (Figure 1).

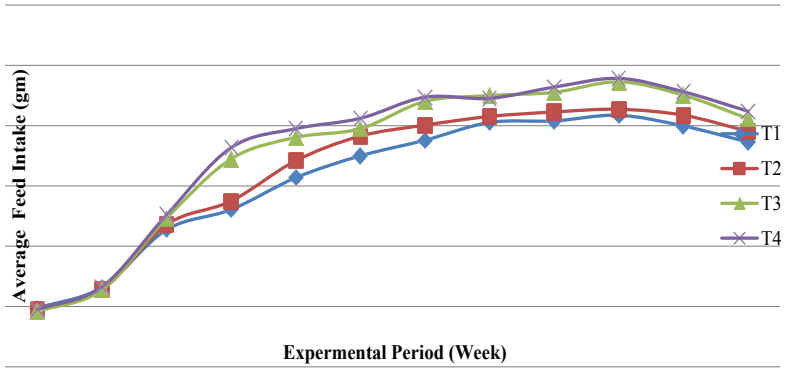
Body weight gain

The initial body weight (IBW), final body weight (FBW), and body weight change (BWC) are presented in Table 5. The results of body weight change, daily body weight gain and final weight in T1, T2, T3 and T4 were significantly different ($P<0.001$) among each other. Chickens fed with high amount of SFM substitution had higher daily BW gain, final BW, and better body weight change compared to those fed with low level substitutes. The highest mean body weight gain per bird was recorded in T4 (1635.48 ± 51.97 g) than the other treatments. This value agrees with the findings of Ferrell [25] and Youssao et al. [26] as they reported 1703.25 and 1699.28 g body weight gain, respectively. The value of current finding was agreed with the finding of Mahdi et al. [13] who reported profound effect of replacement of 5% up to 20% of safflower meal rather than safflower seed with other diet on the body weight gain. These authors reported average final body weight in the range of 1325.23 ± 21.23 to1456.12 ± 25.67 g per the duration of the experimental period. The little variation in the magnitude of average daily gain could be due to the composition of the feed and conversion efficiency of the chickens, as the substitution level of safflower meal increase. Youssao et al. [26], found 1879.16 ± 5.48 g final body weight which was not agreed with the value of current finding. Likewise, Farran et al. [24] showed different values from the current finding. According to these authors, during the experimental period, there was big difference among treatments on their final weight, averagely from (1971.74 up to 2173.33 g). This might be due to the differences in the type and efficiency of treatment of the safflower meal and the nutrient composition of the other ingredients and breed difference and this was agreed with finding of Ojewola et al. [27] (Table 5).

This figure showed that weekly body weight gain trend for the duration of experimental period and it can be give details that there is increasing weekly body weight gain as the substitution level of safflower meal increases. Based on the increasing rate treatments can be ranked T4>T3>T2>T1. However, the degree of increasing rate showed significant variation especially T4 and T1, finely there is declining rate of body weight gain as age of chickens increase and decreasing conversion efficiency (Figure 2).

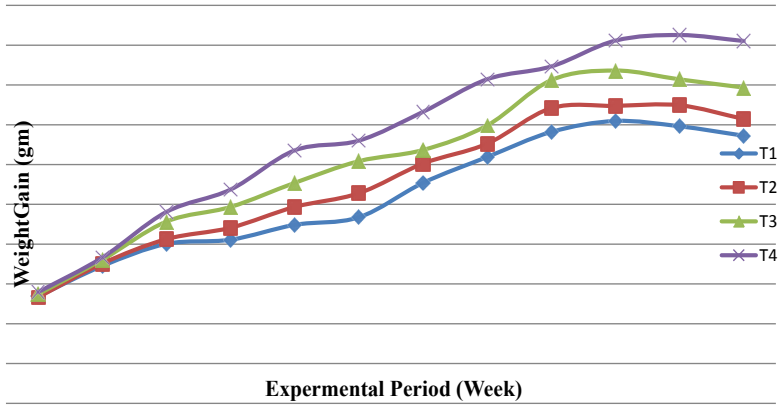
Feed conversion efficiency

The feed conversion efficiency (FCE) of the experimental chicks expressed as body weight gain per grams of dry matter consumption is shown in Table 5. The mean dry matter conversion efficiency expressed as body weight gained per dry matter intake showed significant difference ($P<0.05$) among the dietary treatments. The feed conversion



T1=Treatment One; T2=Treatment Two; T3=Treatment Three; T4=Treatment Four

Figure 1: Effect of safflower meal substitution on feed intake trend during the feeding trail period (12 weeks) of age.



T1=Treatment One; T2=Treatment Two; T3=Treatment Three; T4=Treatment Four

Figure 2: Effect of substitution of safflower meal on weekly body weight gain trend of experimental birds (12 weeks) age.

Parameter	T1	T2	T3	T4	Mean	MSE	sign	CV
IW (g)	253.5	255.6	273.53	273	263.9	24.78	Ns	9.39
FW (g)	1507.76^{c}	1565.6^{c}	1722.4^{b}	1908^{a}	1676	62.2	**	3.7
DWG(g/day)	13.9^{c}	14.55^{c}	16.1^{b}	18.17^{a}	15.67	0.57	***	3.67
BWG (gm)	1254.2 ^{b}	1310 ^{b}	1448.8 ^{a}	1635.4 ^{a}	1412.7	51.97	***	3.68
FCE	0.16^{b}	0.16^{b}	0.16^{b}	0.186^{a}	0.17	0.007	*	4.47

^{a,b,c,d}Means with different superscripts in a row are significantly different at=(P<0.001).
Ns: Non Significant ;T1=control (100%soybean meal); T2=(20%safflower meal); T3=(40%safflower meal); T4=(60% safflower meal); IW: Initial Weight; FW: Final Weight; DWG: Daily Weight Gain; BWG: Body Weight Gain; FCE: Feed Conversion Efficiency; MSE: Mean Standard Error; Sig: Significant; CV: Coefficient of Variance
*(P<0.05); highly significant at **(P<0.01); highly significance at ***(P<0.001)

Table 5: Body weight gain and feed conversion efficiency of SASSO X RIR crossbreed chicks during the experimental period (12 weeks age).

efficiency of birds in this experiment increased with increasing level of safflower meal replacement. A group fed with a diet containing T1, T2, and T3 had significantly lower dry matter conversion efficiency compared with a group that fed a diet containing T4. However this result was contradicted with the findings of Patwardhan et al. [18] who revealed significant difference in feed efficiency ratio with diets 0, 10, 20%, and 40% inclusion level of dehulled safflower meal. The finding of current research also shows that feeding of high amount of oil seed meal such as safflower meal could be better for the overall performance of the chicks in TMR. This clearly addressed that the efficiency of safflower meal can replace for soybean meal up to 60% either to avoid a harmful effect on weight gain or feed utilization efficiency. This finding has similar opinion with the idea of Abu [28] as he noted that by substituting safflower meal up to 75% with tomato pomace and corns the higher feed conversion efficiency was obtained at the higher safflower inclusion level. In addition, Ojewola et al. [27] stated that the variation in FCE and weight gain on poultry can be adjusted by feeding treated and improved feed grains not only that conventional type but also prefer to use locally available grains and meals.

Partial budget analysis

The partial budget analysis for the feeding trial is presented in Table 6. The selling price of the birds after the end of the experiment was decided by the recommendation of experienced enterprises and other concerned livestock production experts by considering the former feed cost and performance of the birds. The result of the partial budget analysis indicated that the total return obtained in this trial was 112.67, 122.67, 132.67 and 132.67 Birr per chickens fed T1, T2, T3 and T4 diets, respectively. Accordingly, the net returns from T1, T2, T3 and T4 were 64.08, 73.53, 81.44 and 81.87 ETB/bird, respectively. Birds received 60% safflower meal (T4) replacement returned higher net income followed by birds fed 40% safflower meal. (T2) 20% safflower

Parameter	Treatment			
	T1	T2	T3	T4
PP birds	22.33	22.33	22.33	22.33
CGI kg/bird	3.82	3.83	4.2	4.2
SBMI/bird	2.74	2.29	1.87	1.27
SFMI kg/bird	0	0.57	1.24	1.8
NSCI kg/bird	0.27	0.31	0.26	0.31
WSI kg/bird	0.72	0.8	0.86	0.93
TCCG Eth .Birr/bird	23.3	23.38	25.82	25.82
TCSBM Eth .Birr/bird	19.8	18.25	15.27	12.17
TC SFM Eth. Birr/bird	0	2.33	3.91	5.89
TC NSC Eth. Birr/bird	1.79	2	1.73	2.05
TCWS Eth .Birr/bird	3.7	4.16	4.5	4.87
TVC(Eth.birr)	48.59	50.52	51.23	50.8
SP Eth .Birr/bird	135	145	155	155
TR	112.67	122.67	132.67	132.67
NR	64.08	73.53	81.44	81.87
ΔNR (ETB)	-	9.45	17.36	17.79
ΔTVC(ETB)	-	1.92	2.64	2.21
MRR% (ΔNR/ΔTVC)		4.92	6.57	8.04

PP: Purchasing Price; SP: Selling Price; TCCG: Total Cost of Corn Grain; TCSB: Total Cost of Soyabean Meal; TCNSC: Total Cost of Noug Seed Cake; TCWS: Total Cost of Wheat Short; TCSFM: Total Cost of Safflower Meal; CGI: Corn Grain Intake; SBMI: Soyabean Meal Intake; SFMI: Safflower Meal Intake; WSI: Wheat Short Intake; NSCI: Noug Seed Cake Intake

Table 6: Feed consumed, production cost and economic benefit of replacing soybean meal with safflower meal (all costs were presented by Ethiopian Birr).

substitution and the control group (T1) were the lowest net return. In other words, the feed cost per kg decreased with increasing safflower meal. More specifically, the feed containing 60% safflower meal was the cheapest feed compared to the others. The low price of safflower meal resulted in positive effect on economic value of production. The

differences in total return, net return and MRR among the treatments is mainly associated with the differences in selling price of the birds and differences in intake and cost of the replacement feeds among the treatments. Based on this, it could be concluded that soybean meal could be replaced by safflower meal in chick's rations at the level of 60% without any adverse effect on growth performance of chicks so as to increase the economic efficiency (Table 6).

In this study, no mortality was recorded throughout the period of the experiment, this is in agreement with Ehsani et al. [29] and which was reported that substitution of different meal products for soybean meal do not cause any fatal death to chicken.

Conclusion and Recommendation

Based on the result of this study, it can be concluded that safflower meal can efficiently substitute soybean meal up to 60% in SASSO x RIR crossbred chicks diet without affecting feed intake, body weight gain and feed conversion ratio. For this reason, replacing of soybean meal with safflower meal at 60% of TMR (T4) would be recommended as the biological optimum for raising chicks. Thus, this result clearly indicated that the inclusion of safflower meal at 60% of TMR in chicks ration reduces production cost, economically feasible and brought high economic efficiency without affecting feed intake, weight gain and feed conversion efficiency of chicks as compared to the control diet. Therefore, safflower meal as substitute of soybean meal for poultry diet initiates rural smallholder farmers to cultivate safflower crop in low productive potential land, which leads an increase income source for safflower crop producers, and accessibility of protein source diet for poultry enterprises in the country.

Therefore, based on the present finding the following future work can be recommended:

- The current finding showed that safflower meal can substitute for soybean meal in dual purpose poultry ration perhaps at 20, 40 and 60% without adverse effect; accordingly it is important to look the effect on dual chickens' performance by replacement of safflower meal greater than the current substitution level.
- In the current study tannin and other anti- nutritional factors of the safflower meal variety are not addressed, it is therefore, of paramount importance to look in to these aspects of some potential varieties for further studies.
- It is better to work in technology based processing factories for farther betterment of or accesses of the safflower meal product.

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