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EFFECT OF FEEDING MEXICAN SUNFLOWER LEAF FEED ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF COMMERCIAL BROILERS

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ABSTRACT

There is increasing demand for poultry products globally; however, the feed costs are so high covering over 80% of total costs of production. Present research investigated the growth performance and carcass characteristics of commercial broilers feeding on inclusion of Mexican sunflower leaf feed (MSLF) as an inexpensive alternative feed. Two experienced farmers were identified and selected and each allocated 420 chicks that were fed on varying levels of MSLF up to the point of sale. Data on growth performance and carcass characteristics were collected and analyzed. Results showed that average final body weight (AFBW), average weight gain (AWG), and average feed conversion ratio (FCR) were significantly different. Significant reduction in the AFBW of broilers was as well observed as the inclusion rate of MSLF increased from 0 to 12% with MSLF12 recording the lowest (436.70g). MSLF0 recorded the highest weight gain (1208.63g) whereas MSLF12, the lowest (394.17g). Results further showed a steady reduction in feed consumption (FC) across various rates of MSLF. MSLF0 expressed the highest (120.39g). FCR was highest for MSLF12 (0.24). A significant difference (P >0.05) among the various inclusion rates was noted for slaughter and carcass weights. MSLF8 was significantly lower and different when compared to MSLF0, MSLF1, MSLF2 MSLF3, and MSLF4 for slaughter weight. The slaughter and carcass weights of birds fed 0%, 1%, 2%, and 3% MSLF diet were higher than those fed on 4%, 8%, and 12% MSLF. In conclusion, growth performance and carcass characteristics and cut portion yield are significantly reduced with increasing

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inclusion rate of MSLF. Inclusion rates of MSLF3, MSLF2, and MSLF1 are the most optimum and can be used without affecting performance of broilers.

KEYWORDS: Mexican sunflower leaf feed, inclusion rate, growth performance, carcass characteristics and cut portion yield.

1. INTRODUCTION

Globally, there is increasing demand for poultry products [1]. This is attributed to the alleged healthiness of chicken, higher profit margins over a short period, and high acceptability of poultry products in many culinary traditions [2]. However, the feed costs are so high covering over 80-55% of total costs of production, with maize and soybean meal being the mostly used conventional feed ingredients [3],[4]. Future predictions on use of soybean meal use as a protein source for both humans and animals pointed out potential problems mainly due to factors such as availability, the risk of over-reliance on a single ingredient and production costs [5]. According to [6] and [7], there has been high competition for the consumption of traditional protein sources between human beings and the livestock industry in the last two decades, which has resulted in an inadequate supply of dietary proteins. As such, soybean has been the primary dietary source of plant protein, although currently its production has not been sufficient to meet the protein demands of the increasing human population and expanding livestock industry [8]. Fishmeal and soybean now occupy central roles in poultry feeds. Nevertheless, their inadequate supply has led to a rise in the price of poultry feed. Ultimately this has affected the growth of the poultry industry, particularly in developing countries [9]. Hence, to meet the protein demands, recent research trends have focused on finding alternatives to dietary protein in poultry diets [9]. The use of non-conventional feed materials could sustain the poultry industry by alleviating the shortage of feed materials [10]. The need for such conventional feed materials has never been so real than the present era that humankind world-over finds themselves in. Since the outbreak of the coronavirus disease (COVID-19) pandemic, we have experienced a 2% decrease in production; as well as global chicken meat reduction of 1% [11]. Among other reasons, these reductions may be due fluctuations of poultry supplies and feeds. Consequently, nutritionists are constantly in search of alternative feed ingredients that are readily available, affordable and nutritious [12]. Mexican sunflower leaf feed (MSLF) an inexpensive by-product of agro-industry origin is one promising alternative feed ingredient that can partially replace the inclusion of soybean meal in poultry diets [13]. It is of broad availability globally, due to its wide adaptability to a range of soil and climatic conditions, it is rich in crude protein content, methionine, and has limited anti-nutritional factors [14], [12]. MSLF has high level of crude protein and energy which are essential in poultry productivity ([15], [16]. Even though studies on the use of MSLF on broiler production are few [9], there is a scarcity of studies on its effects on growth performance and carcass characteristics in broilers. Thus, the purpose

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of this study was to investigate the growth performance and carcass characteristics in broiler in commercial broiler production as affected by the inclusion of MSLF in broiler diets.

2. MATERIALS AND METHODOLOGY

2.1. Research design and experimental lay out

A total of 420-day-old broiler chicks of mixed sex were procured from a reliable commercial supplier for use in the study. Two experienced farmers in Mukono districts (Latitude: 0.480567; Longitude: 32.770567) were identified and selected and each was allocated 210 chicks to be reared up to the point of sale. At placement, birds were weighed and randomly distributed among 21 floor 2ft x 2ft pens with seven treatment groups, each with ten birds, replicated three times in completely randomized block design (Figure 1). The chicks were taken care of while following animal husbandry good practices for poultry production [17]. They were also fed on formulated feeds with the inclusion of the Mexican sunflower leaf feed (MSLF) at various levels following adjusted procedure of [1]. Dietary treatments consisted of seven levels of MSLF: 0% MSLF (control); 1% MSLF; 2% MSLF; 3% MSLF; 4% MSLF; 8% MSLF; and 12% MSLF.

Replicates	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks
	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks
	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks	10 chicks
Treatments	**0% MSLF**	**1% MSLF**	**2% MSLF**	**3% MSLF**	**4% MSLF**	**8% MSLF**	**12% MSLF**

Figure1: Experimental layout for commercial broiler birds fed on varying levels of Mexican sunflower leaf feed

2.2. Data types and data collection

The growth performance parameters were average body weight, average weight gain, feed intake, and feed conversion ratio. Feed allocation per pen was recorded on daily basis. Body weight per pen was recorded at placement, and at weekly intervals, i.e. at 7, 14, 21, 28, 35 and 42 days old. Feed consumption (FCO) was calculated as feed given daily minus feed left for that day. Feed conversion ratio (FCR) was calculated as feed intake/bodyweight-gain [18]. At day 42, three birds were randomly selected per treatment, weighed individually and fasted for eight hours with ad-libitum water supply before slaughter. During slaughter, birds were re-weighed before being sacrificed. The

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birds were fully bled, scalded, plucked and washed. The head, neck, and feet were removed. Subsequently, the carcasses were manually eviscerated; cutting off the neck and through the respiratory system, and the esophagus was removed, before they were placed in a chiller (4°C) overnight for dripping and cooling. Visceral organs and gizzards were removed by hand through an opening round the vent and sternum. Carcasses and visceral organs were then weighed individually. The drumsticks, thighs, and wings were cut from the joints of the carcasses and through the shoulder area to remove the backbone from the breast. The cuts were then weighed, and the yields were calculated as percentages of live bodyweight.

2.3. Data analysis

Growth performance and carcass trait data were subjected to ANOVA using STATA version 14 under a completely randomized design. The significance of means of growth performance and carcass trait were compared using student's t-test.

3. RESULTS AND DISCUSSION

3.1. Growth performance characteristics of commercial broilers

Table1 presents the results of the growth performance characteristics of commercial broilers that were feeding on various inclusion rates of Mexican sunflower leaf feed (MSLF). Average final body weight was significantly different ($p<0.001$) for MSLF-12% (235.2a), MSLF-8% (293.1c), and MSLF-4% (431.4ab), whereas, MSLF-12% (192.7a), MSLF-8% (249.6c), and MSLF-4% (389.4 ab) were significantly different ($p<0.001$) for Average weight gain. Similarly, average feed conversion ratio was significantly different ($p<0.001$) for MSLF-12% (0.2449c), MSLF-8% (0.2176b), and MSLF-4% (0.1641ab). The results showed that the inclusion of MSLF in broiler diets influences growth characteristics comparable with the control diet [19]. However, according to [20], other different factors as well contribute to this situation, and these may include: genetic variation, physiological changes and changes in the mucosa of the small intestine.

Table 1: Growth performance characteristics of commercial broilers

Parameter	Mexican sunflower leaf feed Inclusion Rate (%)						
	$MSLF_0$	$MSLF_1$	$MSLF_2$	$MSLF_3$	$MSLF_4$	$MSLF_8$	$MSLF_{12}$
Avg. Final Body Weight (AFBW) (g)	599.6^b	586.8^b	575.5^b	569.3^b	431.4^{ab}	293.1^c	235.2^a
Avg. Weight Gain (AWG)(g)	555.8^b	542.3^b	531.9^b	528.6^b	389.5^{ab}	249.6^c	192.7^a
Avg. Feed Consumption (AFC)(g)	64.39^a	63.14^a	62.04^a	61.64^a	60.28^a	55.41^a	48.83^a
Avg. Feed Conversion Ratio	0.133^a	0.1358^a	0.1315^a	0.13^a	0.1641^{ab}	0.2176^b	0.2449^c

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(FCR)

$MSLF_0$, $MSLF_1$, $MSLF_2$, $MSLF_3$, $MSLF_4$, $MSLF_8$, and $MSLF_{12}$: Mexican sunflower leaf feed at Inclusion Rates of 0%, 1%, 2%, 3%, 4%, 8% and 12%, respectively.
Note: Means with same superscript letter in same row are not significantly different ($p>0.05$), **Data source:** Experiment, 2022

3.2. Means of body weight and weight gain of commercial broilers

The effect of the various inclusion rates of Mexican sunflower leaf feed on average body weight and average weight gain of commercial broilers for the periods 1 to 7 days, 8 to 14 days, 15 to 21 days, 22 to 28 days, 29 to 35 days and 36 to 42 days old, respectively, are shown in Table 2 and figure 2 and 3. A significant reduction in the average body weight of broilers were as well observed as the inclusion rate of Mexican sunflower leaf feed increased from 0 to 12%, with MSLF12 recording the lowest average body weight (436.70g) whereas MSLF8, MSLF4, and MSLF3, MSLF2, MSLF1, MSLF0, respectively, recorded the highest (508.33g, 831.77g, 1185.90g, 1229.78g, 1230.05g, and 1252.37g). Similar observations were recorded for weight gain, with MSLF0 -followed by MSLF1, MSLF2, and MSLF3, respectively, recording the highest (1208.63g, 1186.32g, 1179.02g, and 1170.58g), whereas, MSLF4, MSLF8, and MSLF12, the lowest, respectively (789.83g, 464.83g, and 394.17g), on day 42. This observation could be explained by the bulkiness of the feed with low nutrient concentration per unit volume, which made it difficult for the birds to satisfy their protein and energy requirement [21] as well as the presence of anti-nutritional factors like tannins and saponin which are known to decrease digestibility of protein and other nutrients [22]. Tannins can bind with dietary protein and digestive enzymes and can also bind with proteins of saliva and mucosal membranes [23]. [24] reported similar results when TDLM was included up to 10% level in the ration in broilers. Relatedly, [25] on sunflower meal inclusion rate and the effect of exogenous enzymes on growth performance of broiler chickens and [26] in line with the reports of [27] on cultivated sunflower meal as well as [28] on wild sunflower meal, reported similar findings. Similarly, [29] reported significantly reduced live weight of broilers when inclusion of wild sunflower forage meal exceeded 10% level.

Table 2: Average body weight and weight gain of commercial broilers

	Mexican sunflower leaf feed Inclusion Rate (%)						
Parameter	$MSLF_0$	$MSLF_1$	$MSLF_2$	$MSLF_3$	$MSLF_4$	$MSLF_8$	$MSLF_{12}$
Average Final Body Weight (AFBW) (g)							
Day-1	43.73	42.53	42.61	43.72	41.93	43.50	42.53
Day-7	128.10	124.20	123.93	123.74	112.63	102.43	91.20
Day-14	247.17	214.52	214.25	214.06	199.60	153.37	126.03
Day-21	441.07	432.46	432.19	432.01	315.73	218.57	186.53

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Day-28	617.33	603.25	602.98	602.98	473.87	312.93	236.53
Day-35	911.37	910.05	909.78	908.84	654.70	463.07	334.37
Day-42	1252.37	1230.05	1229.78	1185.90	831.77	508.33	436.70
Mean	**599.57**	**585.76**	**576.49**	**573.92**	**431.38**	**293.12**	**235.23**
Average Weight Gain (AWG)(g)							
Day-7	84.37	80.47	80.20	79.01	70.70	58.93	48.67
Day-14	203.43	170.79	170.52	169.33	157.67	109.87	83.50
Day-21	397.33	388.72	388.45	387.26	273.80	175.07	144.00
Day-28	573.60	559.52	558.25	549.06	431.93	269.43	194.00
Day-35	867.63	866.32	861.05	855.86	612.77	419.57	291.83
Day-42	1208.63	1186.32	1179.02	1170.58	789.83	464.83	394.17
Mean	**555.83**	**542.02**	**539.58**	**535.18**	**389.45**	**249.62**	**192.69**

$MSLF_0$, $MSLF_1$, $MSLF_2$, $MSLF_3$, $MSLF_4$, $MSLF_8$, and $MSLF_{12}$: Mexican sunflower leaf feed at Inclusion Rates of 0%, 1%, 2%, 3%, 4%, 8% and 12%, respectively.

Data source: Experiment, 2022

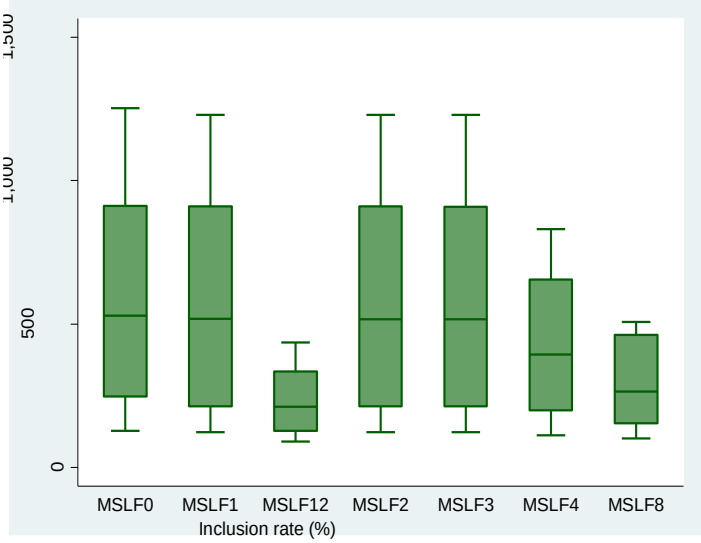

Figure 2: Effect of varying inclusion rates of Mexican sunflower leaf feed on average body weight
Data source: Experiment, 2022

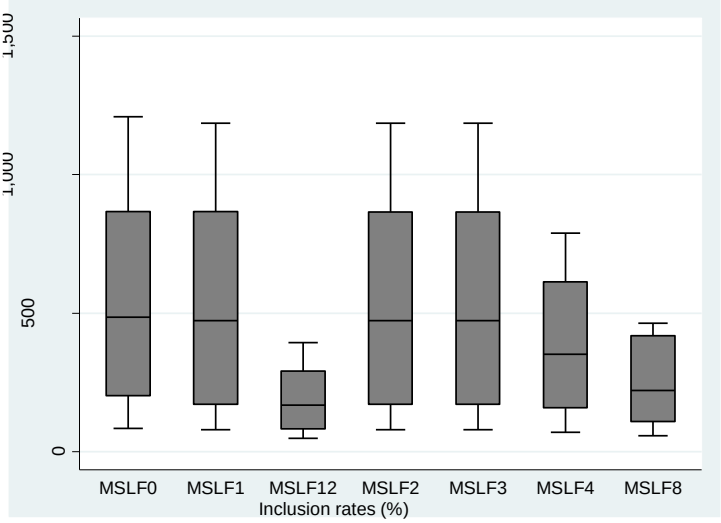

Figure53: Effect of varying inclusion rates of Mexican sunflower leaf feed inclusion rates on average weight gain
Data source: Experiment, 2022

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3.3. Means of feed consumption and feed conversion ratio of commercial broilers Intake of MSLF

Results in table 4 showed a steady reduction in feed consumption across various rates of MSLF from weeks 1 to 6. MSLF0 expressed the highest (120.39g) feed consumption, followed by MSLF1, MSLF2, MSLF3, MSLF4, MSLF8, and MSLF12 which recorded the lowest, respectively (119.09g, 117.99g, 117.59g, 114.00g, 108.43g, and 96.29g). Various studies support the notion of a decline in feed consumption of diets with high energy [30], [31], [32]. This could be due to high fat content and therefore low palatability of sunflower consumption of the experimental MSLF [32], [33], [34], [29], [35]. The decrease in feed consumption is further supported by [47], who noted that feed consumption decreases linearly as dietary energy increases with high energy in diets. Conversely, MSLF diets were consumed by the broiler chicks even at the highest (MSLF12) inclusion level, and this may be attributed to the good aroma of the sun flower seed cake. This is supported by [36], [37], and [9], who reported that the Baobab seed oilcake has a good aroma that improves feeds consumption.

Table 3: Means of feed intake and feed conversion ratio of commercial broilers

	Mexican sunflower leaf feed Inclusion Rate (%)						
Parameter	$MSLF_0$	$MSLF_1$	$MSLF_2$	$MSLF_3$	$MSLF_4$	$MSLF_8$	$MSLF_{12}$
Average Feed Consumption (AFC)(g)							
1-7 (wk_1)	16.44	15.44	14.34	13.94	14.60	13.52	11.96
8-14 (wk_2)	29.56	28.29	27.19	26.79	25.86	21.30	18.08
15-21 (wk_3)	45.02	43.72	42.62	42.22	41.78	34.60	28.02
22-28 (wk_4)	73.53	72.23	71.13	70.73	68.80	62.61	54.10
29-35 (wk_5)	101.40	100.10	99.00	98.60	96.64	91.97	84.52
36-42 (wk_6)	120.39	119.09	117.99	117.59	114.00	108.43	96.29
Mean	**64.39**	**63.15**	**62.05**	**61.65**	**60.28**	**55.41**	**48.83**
Feed Conversion Ratio (FCR)							
1-7 (wk_1)	0.19	0.19	0.18	0.17	0.21	0.23	0.25
8-14 (wk_2)	0.11	0.17	0.16	0.16	0.15	0.20	0.19
15-21 (wk_3)	0.13	0.11	0.11	0.11	0.16	0.23	0.28
22-28 (wk_4)	0.12	0.13	0.13	0.13	0.16	0.22	0.29
29-35 (wk_5)	0.10	0.12	0.11	0.11	0.14	0.23	0.24
36-42 (wk_6)	0.15	0.10	0.10	0.10	0.16	0.19	0.22
Mean	**0.13**	**0.14**	**0.13**	**0.13**	**0.16**	**0.22**	**0.24**

$MSLF_0$, $MSLF_1$, $MSLF_2$, $MSLF_3$, $MSLF_4$, $MSLF_8$, and $MSLF_{12}$: Mexican sunflower leaf feed at Inclusion Rates of 0%, 1%, 2%, 3%, 4%, 8% and 12%, respectively.

Data source: Experiment, 2022

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3.4. Feed conversion ratio of MSLF

Feed conversion ratio was highest for MSLF0 (0.24) compared to MSLF1, MSLF2, MSLF3, MSLF4, MSLF8 and MSLF12 which recorded the lowest, respectively, (0.22, 0.16, 0.14, 0.13, 0.13 and 0.16). Decreasing trend in FCR might be due to decreasing growth rate and hence the body weight of birds decreased as inclusion level of MSLF was increased. High fibre levels are known to reduce the digestibility of poultry diets [38], [39], [40] [41]. According to [42] and [32] the inclusion of insoluble fibre in poultry diets at moderate levels has no detrimental effect on their performance although the nutrient concentration of the diet is reduced. Nevertheless, dilution in fibre beyond the optimal inclusion level causes lower feed intake, probably owing to an increase in the viscosity of the digesta and a longer retention period of the digesta in the gut [43], [32]. Lower metabolizable energy tends to reduce growth performance of broiler chickens due to high concentrations of non-starch polysaccharides, which has an inverse effect on dietary energy levels. On contrary, according to [44], higher levels of insoluble fibre in poultry diets have always been associated with negative effects of reduction of nutrient digestibility, absorption and feed intake, thus feeding diets rich in fibre in poultry tend to increase feed intake as a way of compensation for the reduced concentration of nutrients, mainly energy level, in the diets. [45] also reported decreased digestibility of nutrients with increased pawpaw (Carica papaya) leaf meal inclusion in Japanese quails.

Body weight, weight gain, feeds consumption and feed conversion ratio observed for broilers feeding on 1%, 2% and 3% MSLF inclusion were comparable to those in the control group. This means that broilers can tolerate MSLF at up to 3% inclusion level without an adverse effect on their growth in a similar manner reported for full fat sunflower [29], [27]. Chickens are generally unable to breakdown phytate and non-starch polysaccharides that are present in most raw materials of plant origin due to their inability to secrete phytase and non-starch polysaccharides-hydrolyzing enzymes [46].

3.5. Effects of MSLF inclusion in broiler feed on carcass characteristics and cut portion yield of broilers

The effect of Mexican sunflower leaf feed inclusion on slaughter weight, carcass weight, dressing percentage and cut part yield are presented in Table 5. A significant difference (P >0.05) among the various inclusion rates was noted for slaughter and carcass weights. MSLF8 was significantly lower and significantly different where compared to MSLF0, MSLF1, MSLF2 MSLF3, and MSLF4 for slaughter weight. The dressing percentage and cut part yields of broilers at day 42 were not affected by the inclusion of MSLF in the diets, except for the slaughter weight and carcass weight. The results showed that the inclusion of MSLF in broiler diets produced similar results on carcass characteristics and yield comparable with the control diet. However, the slaughter and carcass weights of birds fed 0%, 1%, 2%, and 3% MSLF diet was higher than those fed on 4%, 8%, and 12% MSLF. This can be attributed to the general growth

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performance of the birds on MSLF0, MSLF1, MSLF2, MSLF3 and the nutritional composition of the 0% 1%, 2%, and 3% MSLF diet relative to the other diets. The poor feed utilization in chickens fed with 12% MSLF explains the observed lower slaughter and carcass weights. Bale et al. (2013) noted that a lower feed consumption might be attributed to the increase in the level of residual anti-nutritional factors in MSLF, such as oxalate, phytate, saponins, and tannins. This might have impaired the performance of the birds owing to the incremental levels of fibre and anti-nutritional factors in the diet [7], [32].

Table 4: Effects of MSLF inclusion in broiler feed on carcass characteristics and cut portion yield of broilers

Yield	Dietary treatment (%)							Significance levels
	$MSLF_0$	$MSLF_1$	$MSLF_2$	$MSLF_3$	$MSLF_4$	$MSLF_8$	$MSLF_{12}$	
Carcass characteristics								
Slaughter weight (g)	1252.37	1150.40	1096.32	990.81	831.77	508.33**	436.7	*
Carcass weight (g)	941.28	921.32	916.53	909.28	611.18*	363.76*	298.92*	*
Dressing percentage (%)	75.16	71.22	69.61	66.16	73.48	71.56	68.45	NS
Breast (g)	300.57	294.55	289.33	276.47	199.62	122.00	104.81	NS
Drumstick (g)	69.38	64.50	62.80	59.71	46.08	28.16	24.19	NS
Feet (g)	45.84	44.56	42.68	41.11	30.44	18.61	15.98	NS
Head (g)	28.43	27.51	26.83	25.12	21.63	18.81	13.6	NS
Thigh (g)	100.19	99.15	98.60	92.98	67.87	34.26	28.39	NS
Wing (g)	50.35	49.46	47.80	45.30	33.44	20.43	17.56	NS

$MSLF_0$, $MSLF_1$, $MSLF_2$, $MSLF_3$, $MSLF_4$, $MSLF_8$, and $MSLF_{12}$ are the inclusion rates of *Tithonia diversifolia* leaf feed varied at 0%, 1%, 2%, 3%, 4%, 8% and 12%.

Data source: Experiment, 2022

The average slaughter weight, carcass weight, dressing percentage, and primal cuts weights (breast, drumstick, feet, head, thigh, and wing) were also found to be decreased significantly as the inclusion level of MSLF increased in the ration. This might be because of reduced growth rate of the broilers at higher inclusion level of MSLF as sizes of the organs are proportional to the body size or live weight of the birds because the experimental birds were of same strain with same genetic make-up. No significant difference was observed between groups. However, breast, drumstick, feet, head, thigh, and wing (% dressed weight) were significantly higher in control group as compared to the treatment ones and found to be decreased linearly. Similar findings were also reported by [25] for broilers in Nigeria.

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4. CONCLUSION

Growth performance is significantly reduced with increasing inclusion rate of Mexican sunflower leaf feed from 0 to 12%. Inclusion rate MSLF3, MSLF2, MSLF1 can be used without affecting performance. Carcass characteristics and cut portion yield are significantly reduced with increasing inclusion rate of Mexican sunflower leaf feed from 0 to 12%.

5. ACKNOWLEDGEMENT

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