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Effect of Azolla Supplementation on the Carcass Characteristics of Deccani Ram Lambs reared under Grazing Based Production System

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Abstract

A study was conducted for 120 days using 18 weaner ram lambs to study the effect of Azolla pinnata supplementation on carcass traits of lambs reared under grazing based production system in Mahbubnagar district of Telangana state. The study revealed that the carcass characteristics such as pre slaughter weight (PSW), empty live weight (ELW), hot carcass weight, total edible organs and total inedible organs were significantly higher in T3 group (20% azolla), followed by T2 (10% azolla) and T1 group (0% azolla). The dressing percentage on PSW was significantly higher in T3 lambs (47.24 percent) followed by T2 lambs (44.91 percent) and T1 lambs (40.75 percent). Carcass length was also found to be significantly ($p<0.05$) higher in T3 with 94.25 cm, followed by T2 with 94.15 cm and T1 with 94.00 cm. Loin eye area was found to be significantly ($p<0.05$) higher in T3 with 7.61 cm2 than T2 (7.59 cm2) and T1 (7.59 cm2). There was no significant difference in percentage carcass weight of wholesale cuts except neck and shoulder, which was significantly higher in T1 group followed by T3 and T2 group. The percent yield of meat, bone and fat were non-significantly different between the groups.

Keywords: *Azolla pinnata*, Carcass Traits, Deccani Lambs, Grazing Based Production System and Wholesale Cuts

Introduction

The migration from the rural areas to urban areas and consequent increase in the demand for quality food due to increased purchasing power is leading to a pressure on production and productivity on unit basis. The quality consciousness is leading to an increased demand for protein rich foods especially the meat-based products. As per FAO, the total meat production from India in 2019 was about 7.74 million tonnes, of which meat from sheep was about 0.73 million tonnes (FAO, 2020). Meat and Meat products not only provide nutrients but also ensures food security and livelihood to a large population.

The sheep population of Telangana was 1,90,63,058 (DAH, 2019), of which Mahbubnagar district was contributing about to 12.07% of the total sheep population. Deccani sheep are native to Telangana and are small in size, with low grade in wool quality reared chiefly for mutton production. The majority of the farmers of Telangana follow the traditional practice of an extensive rearing system in which intake of quality nutrients is minimal, especially proteins, thereby causing delayed maturity and more time to reach the market which in turn delay the realization of income. Moreover, Deccani sheep are hardy and have the potential to grow fast, if they are provided with some supplementation in the form of protein and required nutrients.

Azolla pinnata is a good source of protein (Indira *et al.,* 2009) and has a high nutritive value as it contains almost all essential amino acids (Alalade and Iyayi, 2006) and minerals such as iron, calcium, magnesium, potassium, phosphorus, manganese, and also appreciable quantities of vitamin A precursor beta carotene and vitamin B12. Azolla was also found to contain probiotic and bio polymers (Pillai *et al.,* 2002). Wadhwani *et al*. (2010) stated that the incorporation of Azolla in weaner lamb's ration had no adverse effects on carcass trait. Therefore, a study was planned to understand the effect of inclusion of azolla as a supplement on the carcass traits of lambs reared under grazing based production system.

Materials and Methods

The research was conducted for 120 days at Livestock Research Station (LRS), Mahbubnagar district in Telangana. Eighteen lambs in the age group of 3-4 months were selected basing on their body weights and are randomly divided into three treatment groups of six lambs each in a completely randomized design (CRD). Azolla was cultivated in three pits, each with a dimension of 5m x 4m with 0.3m depth. Azolla was harvested every week from all the pits was washed thoroughly with clean water, shade dried such that it becomes crispy while green color still retained and were stored in airtight bags for further use. The lambs were divided into three experimental groups (T1, T2 and T3) with six weaner lambs in each group such that the group average weights were uniform. The ram lambs of T1, T2 and T3 groups were allowed to graze daily from 9:00 AM to 4:00 PM. After grazing, T1 group which was taken as a control to the experiment and no azolla was given. The azolla was given as whole feed supplement at 10% and 20% of DM requirement to the T2 and T3 groups respectively.

Deworming was done for all the lambs with Albendazole @ 10 mg per kg body weight at the beginning and in the middle of the research. All the animals were kept in a well-ventilated shed with adequate space requirement providing ad libitum of hygienic water for the purpose of drinking. The shed was disinfected and cleaned regularly with bleaching water and allowed to dry before the arrival of lambs from grazing.

Slaughter of Lambs

After 120 days of experimental period, two ram lambs from each treatment group were slaughtered by Halal method to study the carcass traits. As per the protocol, the lambs were starved for 18 hours with water ad libitum prior to slaughter. Stripping, legging, dressing, and evisceration were performed by following the standard procedures described by Gerrand (1964). Pre slaughter weights (weight of the lambs before slaughter) and empty live weights (difference between slaughter weight and weight of digestive content) were recorded. The hot carcass (muscle, bone and fat associated with the slaughter of an animal, left after the removal of the head, hide and internal organs) and dressing percentage (The weight of hot carcass was expressed as percentage of preslaughter weight as well as empty live weight to arrive at dressing percentage) of the carcass were recorded. The carcass length was measured from the point of hock to the point of shoulder (anterior to the joint of scapula-humerus) on the carcass hanging with Achilles tendon and was expressed in cm. The carcass was then split along the vertebral column in to left and right halves. Carcass was dissected into five wholesale cuts namely neck and shoulder, breast and foreshank, rack, loin

and leg as per ISI (1963) specifications. Weights of edible and inedible offals were recorded and quantity of meat, bone and fat was weighed to estimate the percentage. The loin eye area (cm^2) which is an index of muscle growth was measured as a cross-section of *longissimus dorsi* muscle between 12th and 13th rib on both the sides and their average was taken.

Figure 1: Hot carcass

Figure 2: Carcass length

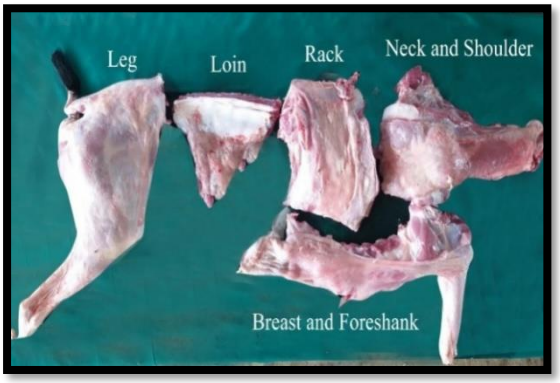

Figure 3: Wholesale cuts

Figure 4: Loin eye area

The data was subjected to standard statistical procedure (Snedecor and Cochran, 1994) to compare the means of different treatment groups by one-way analysis of variance (ANOVA) under Duncan Post Hoc Multiple comparisons by using SPSS statistical software (version 15.0; SPSS, 2006).

Results and Discussion

Carcass Traits of Lambs

Effect of azolla supplementation on carcass traits such as PSW, ELW, hot carcass weight, dressing percentage, carcass length, loin eye area and percent of meat, bone and fat were presented in Table 1. Means of PSW, ELW and hot carcass weight were 19.91±0.30, 15.75±0.31 and 8.11±0.01 kg for T1 group, 22.18±0.26, 18.23±0.33 and 9.97±0.46 kg for T2 group, 24.45±0.10, 20.58±0.12 and 11.55±0.06 kg for T3 group with significant differences ($p<0.01$) between the means of three different groups. Similar observations were reported by Cherryl *et al*. (2014) in pigs, where carcass weight was non significantly higher when fed with 20 % azolla test ration with 55.5±1.50 kg, followed by 10 % azolla test ration with 53.5±0.50 kg, and 0% azolla control ration with 50.75±2.25 kgs. Similar

findings were reported by Rana *et al*. (2017) in broilers, where carcass weight was non significantly high when fed 2.5 % azolla and 5% azolla with carbohydrase and phytase enzyme ration. Saini *et al.* (2018) reported that the hot carcass weight was higher in pigs when fed with 15 % azolla in concentrate ration. Sireesha *et al*. (2017) in New Zealand white rabbits found that the PSW and hot carcass weight were significantly high when fed with 10% azolla. On contrary to the present study, Shekh *et al.* (2016) in lambs reported that the TMR II (10% azolla) and TMR III (20% azolla) groups were found to have low hot carcass weights when compared to TMR I group (0% azolla). In the present study, the highest mean dressing percentage on pre slaughter weight was noticed in T3 lambs (47.24±0.44), followed by T2 lambs (44.91±1.52) and T1 lambs (40.75±0.66), with significant differences among the means of groups. Likewise, highest mean dressing percentage on empty live weight was noticed in T3 lambs (56.14±0.61), followed by T2 lambs (54.65±1.49) and T1 lambs (51.53±1.06) but without any significant difference between the means. Similar observations were reported by Wadhwani *et al*. (2010) in lambs, where dressing percentages on live basis fed on 0, 10 and 20% of azolla were 50.40, 59.63 and 58.21, respectively, but without any significant difference between the means. Cherryl *et al*. (2014) in pigs observed that the azolla inclusion in the diet helped in obtaining non significantly higher dressing percentages when compared to conventional concentrates. Similar findings of higher dressing percentages were reported by Saini *et al*. (2018) in swine, when fed with azolla rations. In the present study, the significant increase in pre slaughter weight might be the reason for the above trend in results.

Table 1: Effect of azolla supplementation on carcass characteristics of Deccani ram lambs

Carcass characteristics	Azolla supplementation		
	T1 (0%)	**T2 (10%)**	**T3 (20%)**
Pre slaughter weight** (kg)	$19.91^{a} \pm 0.30$	$22.18^{b} \pm 0.26$	$24.45^{c} \pm 0.10$
Empty Live weight** (kg)	$15.75^{a} \pm 0.31$	$18.23^{b} \pm 0.33$	$20.58^{c} \pm 0.12$
Hot carcass weight** (kg)	$8.11^{a} \pm 0.01$	$9.97^{b} \pm 0.46$	$11.55^{c} \pm 0.06$
Dressing percentage			
On pre slaughter weight*	$40.75^{a} \pm 0.66$	$44.91^{ab} \pm 1.52$	$47.24^{b} \pm 0.44$
On empty live weight^{NS}	51.53 ± 1.06	54.65 ± 1.49	56.14 ± 0.61
Measurements			
Carcass length* (cm)	$94.00^{a} \pm 0.00$	$94.15^{ab} \pm 0.05$	$94.25^{b} \pm 0.05$
Loin eye area* (cm^2)	$7.59^{a} \pm 0.00$	$7.59^{a} \pm 0.00$	$7.61^{b} \pm 0.01$
Percentage			
Meat^{NS}	60.64 ± 2.38	60.18 ±0.20	64.76 ± 0.05
Bone^{NS}	33.13 ± 2.01	34.90 ± 0.15	29.67 ± 0.09
Fat ^{NS}	6.20 ± 0.35	4.94 ± 0.34	5.56 ± 0.13

** Means with different superscripts in a row differ significantly (p<0.05); ** Means with different superscripts in a row differ significantly (p<0.01);* NS – Non *significant difference*

The mean carcass length was highest in the lambs of T3 group (94.25±0.05 cm) followed by T2 group (94.15±0.05 cm) and T1 group (94.00±0.00 cm) with significant difference between the means (p<0.05). Similar findings were reported by Saini *et al*. (2018) in pigs, where non-significant increase in carcass length was observed with the feeding of azolla. The mean loin eye area was significantly high in the lambs of T3 group (7.61±0.01 cm^2) when compared to T2 group (7.59±0.00 cm^2) and T1 group (7.59±0.00 cm^2) and there was no significant difference between T1 and T2 groups. This is in close agreement with the reports of Cherryl *et al*. (2014) in pigs, where loin eye area was non significantly high when fed with 20% azolla ration. The percent yield of meat, bone and fat in whole carcass given 0%, 10% and 20% azolla were 60.64±2.38, 60.18±0.20, 64.76±0.05; 33.13±2.01, 34.90±0.15, 29.67±0.09 and 6.20±0.35, 4.94±0.34, 5.56±0.13, respectively without significant differences among groups. Cherryl *et al.* (2014), reported significantly less mean fat percentage in pigs of azolla fed group. The present findings of high percentage of meat and less percentage of fat in lambs of azolla supplemented group indicates that the azolla inclusion in the diet helps in higher muscle building.

Yield of Edible Organs

The yield of edible organs such as heart, liver, kidneys, testes and spleen of lambs fed on 0%, 10% and 20% azolla meal were 0.09±0.00, 0.10±0.00, 0.10±0.00 kg; 0.39±0.01, 0.46±0.00, 0.43±0.03 kg; 0.06±0.00, 0.08±0.01, 0.08±0.00 kg; 0.15±0.00, 0.18±0.03, 0.20±0.00 kg and 0.08±0.02, 0.09±0.01, 0.08±0.00 kg, respectively and are presented in Table 2. In the present study, feeding azolla meal at different levels did not affect the weight of the

heart, liver, kidneys, testes, and spleen significantly. The total edible weight ($p<0.05$) was significantly higher in azolla supplemented group T2 (0.90±0.04 kg) and T3 (0.90±0.04 kg), when compared to no azolla fed group T1 (0.77±0.01). Rana *et al*. (2017) in broiler chicken concluded that the edible by-products yield was higher in azolla supplemented diet. However, Cherryl *et al.* (2014) found non significantly high yield of edible offal in swine when fed with conventional concentrates.

Table 2: Effect of azolla supplementation on the yield of edible organs of lambs

Weights of edible organs (kg)	Azolla supplementation		
	T1	T2	T3
Heart^{NS}	0.09 ± 0.00	0.10 ± 0.00	0.10 ±0.00
Liver^{NS}	0.39 ± 0.01	0.46 ± 0.00	0.43 ± 0.03
Kidneys^{NS}	0.06 ± 0.00	0.08 ± 0.01	0.08 ± 0.00
Testes^{NS}	0.15 ± 0.00	0.18 ± 0.03	0.20 ± 0.00
Spleen^{NS}	0.08 ± 0.02	0.09 ± 0.01	0.08 ± 0.00
Total edible organs	0.77^{a} ± 0.01	0.90^{b} ± 0.04	0.90^{b} ± 0.04

a, b Means with different superscripts in a row differ significantly (p<0.05); NS – *Non significant difference*

Yield of Inedible Organs

The yield of inedible organs such as head, hide, blood, forelegs, hindlegs, lungs with trachea and diaphragm, empty stomach, and empty intestine of lambs fed on 0%, 10% and 20% azolla meal were 1.41±0.04, 1.46±0.24, 1.55±0.02 kg; 1.79±0.03, 2.00±0.13, 2.21±0.00 kg; 0.73±0.00, 0.85±0.01, 0.95±0.04 kg; 0.26±0.01, 0.29±0.00, 0.33±0.01 kg; 0.21±0.00, 0.22±0.01, 0.26±0.01 kg; 0.31±0.01, 0.35±0.01, 0.47±0.00 kg; 0.81±0.01, 0.82±0.00, 0.83±0.01 kg and 0.92±0.01, 1.02±0.01, 1.11±0.00 kg, respectively (Table 3). The yield of all the inedible organs, except head and empty stomach differed significantly among the treatments. Total inedible weight ($p<0.05$) was significantly higher in T3 group (7.69±0.09 kg) followed by T2 (7.00±0.38 kg) and T1 (6.43±0.05 kg) group. The observations of present study were in close agreement with the reports of Cherryl *et al*. (2014) in swine. Rana *et al.* (2017) in broiler found that the yield of most of inedible offals were on higher side when azolla was included in the diet.

Table 3: Effect of azolla supplementation on the yield of inedible organs of lambs

Weights of Inedible organs (kg)	Azolla supplementation		
	T1	T2	T3
Head^{NS}	1.41 ± 0.04	1.46 ± 0.24	1.55 ± 0.02
Hide*	1.79^{a} ± 0.03	2.00^{ab} ±0.13	2.21^{b} ± 0.00
Blood*	0.73^{a} ± 0.00	0.85^{b} ± 0.01	0.95^{b} ± 0.04
Fore legs**	0.26^{a} ± 0.01	0.29^{b} ± 0.00	0.33^{c} ± 0.01
Hind legs*	0.21^{a} ± 0.00	0.22^{a} ± 0.01	0.26^{b} ± 0.01
Lungs, trachea and diaphragm**	0.31^{a} ± 0.01	0.35^{b} ± 0.01	0.47^{c} ± 0.00
Empty stomach^{NS}	0.81 ± 0.01	0.82 ± 0.00	0.83 ± 0.01
Empty intestine**	0.92^{a} ± 0.01	1.02^{b} ± 0.01	1.11^{c} ± 0.00
Total inedible organs*	6.43^{a} ± 0.05	7.00^{ab} ± 0.38	7.69^{b} ± 0.09

*** Means with different superscripts in a row differ significantly (p<0.01); * Means with different superscripts in a row differ significantly (p<0.05);* NS – *Non significant difference*

Wholesale Cuts of Slaughtered Lambs

Effect of azolla on the percent of wholesale cuts of hot carcass weight were presented in Table 4. The percent of breast and foreshank, rack, loin and leg of hot carcass weight when fed 0, 10 and 20% azolla were 14.97±0.57, 17.67±1.16, 16.26±0.03; 10.22±0.81, 11.22±1.52, 9.67±0.09; 11.00±0.58, 10.55±0.03, 9.95±0.02 and 34.59±0.84, 35.41±1.73, 37.30±0.02, respectively without significant difference among the groups. The percent of neck and shoulder of the hot carcass weight was significantly higher in the lambs of T1 group (29.21±0.01) when compared to T2 (25.18±0.90) and T3 (26.82± 0.00) group and there was no significant difference between T2 and T3. To substantiate this observation, further studies are needed as no literature was available to compare the same.

Table 4: Wholesale cuts of slaughtered lambs (% carcass weight)

Wholesale cuts	Azolla supplementation		
	T1	T2	T3
Neck and shoulder	$29.21^{b} \pm 0.01$	$25.18^{a} \pm 0.90$	$26.82^{a} \pm 0.00$
Breast and Fore shank^{NS}	14.97 ± 0.57	17.67 ± 1.16	16.26 ±0.03
Rack^{NS}	10.22 ± 0.81	11.22 ± 1.52	9.67 ± 0.09
Loin^{NS}	11.00 ± 0.58	10.55 ± 0.03	9.95 ±0.02
Leg^{NS}	34.59 ± 0.84	35.41 ±1.73	37.30 ±0.02

a, b Means with different superscripts in a row differ significantly (P < 0.05); NS – *Non significant difference*

Conclusion

Inclusion of shade dried azolla up to 20% of dry matter requirement in the lamb diets did not appear to affect the carcass parameters of lambs. Further it was found that, incorporation of azolla in the diets of lambs helped to obtain high carcass weight, dressing percentage and low-fat percentage. It is inferred that the inclusion of shade dried azolla had beneficial effects on the carcass characteristics of Deccani ram lambs.

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Conflict of Interests

There is no conflict of interest.

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