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Study of carcass characteristics and cost economics of Mahbubnagar local kids under different systems of rearing

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Abstract
Significant (P<0.05) difference was found between G1 and G2 groups in the mean PSW, EBW and hot carcass weight while G2 and G3groups had non-significant (P<0.05) difference. The total nonedible offal weight (kg) was higher in G3 (8.23±0.01) than in G1 (7.54±0.00) and G2 (7.79±0.01) groups and significant difference was not observed between the three groups in the present study. The crude protein, ether extract and ash percentage of chevon had non-significant difference between the three groups. The cost per kilogram live weight gain was higher in the G1 group followed by G2 and G3 group.

Keywords: Kid, crude protein, ether extract, ash and cost etc.

Introduction
The total livestock population according to the 20th census in India is 536.76 million and the total goat population is 148.88 million i.e., 27.8% of the total livestock is contributed by goats in the country. Total goat population in India has increased by 10.14% over previous Livestock Census. Goat is considered the most promising livestock species for commercial meat production second to the poultry in the country (Chowdhury *et al.*, 2002) [7]. India ranks first in the world's goat milk production, second in goat population and goat meat production, and is also the largest exporter of goat meat to other countries in the world. Major export destinations are United Arab Emirates, Saudi Arabia, Qatar, Kuwait, and Oman in descending order (APEDA 2021) [4]. Major state's contribution to goat meat production in India are Uttar Pradesh (15.1%), followed by Maharashtra (12.6%). However, now-a-days many young entrepreneurs are setting up goat/sheep units using scientific rearing practices. Improving economic status, the demand for high-quality meat products, the shifting population of metropolis cities, and a shift in family values toward animal protein are all likely to drive up demand for chevon/mutton in the future (Sahoo *et al.*, 2015) [30]. However, the demand for goat meat, which is leaner and has low cholesterol, is expected to rise at a faster pace in the domestic as well as international markets (Kumar *et al.*, 2010) [20]. Total population of cattle and buffaloes is 90.5 lakh, Sheep and Goat are a total of 1.74 crore in the 31 districts of Telangana. Mahbubnagar local goats are also known by in local Telugu dialect name as "Palamuru Mekalu' are found in and around the area adjoining the Serialism hydel project and the Nallamala forest in the Mahbubnagar district of Telangana State. This local strain of goat is reared by farmers in small size flocks mainly for meat. The local strain is known for its high prolificacy.

Materials and Methods
The present study was undertaken at Livestock Research Station, Mahbubnagar district, situated between $77^0$15' and 79^0 15'E, of eastern longitudes and $15^0$55' and 17^0 20N, of northern latitudes. For the study thirty six Mahbubnagar local kids selected. The kids born during the reproductive study in each rearing system were used to study the growth performance of kids from birth to weaning and thirty-six Mahbubnagar local kids three months were selected in a Complete Randomized Design (CRD). This kid assigned to each of the rearing systems (3x36) viz., Intensive group (G1), Semi-intensive group (G2), and Extensive group (G3).

Carcass Trait Studies

At the end of the growth study, three buck kids from each group (3x3=9, CRD) were slaughtered to find out the effect of different rearing systems on carcass traits of goats. The animals were fasted for 12 hrs with free access to water and slaughtered by the 'Halal' method. After slaughter, the head was removed at the atlantooccipital joint and the forefeet and hind feet were removed at the carpal and tarsal joints, respectively. The carcass and non-carcass components were weighed immediately after slaughter and recorded. Edible offal's comprised of testes, spleen, kidney, liver, and heart. Inedible offal's constituted blood, lungs, intestines, head, and skin. The dressed carcass was split along the midline and the left half was disjointed as per ISI specifications (1963) into standard cuts. The carcass traits such as hot carcass weight (kg), edible and non-edible ratio, and dressing percentage were recorded.

Empty Body Weight (EBW)

The weight was recorded after deducting blood and gut fill from pre-slaughter weight and was noted as empty body weight.

Organ Weights

The weight of liver, heart, kidney, pluck (lung with trachea, liver, and heart) and full and empty gastrointestinal tract (GIT) were expressed as percentages of pre-slaughter weight.

Dressing Weight

The weight of the hot carcass was expressed as a percentage of pre-slaughter weight as well as Empty bodyweight to arrive at the dressing percentage.

Composition of Meat

Longissimus Dorsi muscle was collected from the slaughtered carcass for meat analysis. The muscles were packed in polythene bags and kept in the deep freezer with proper labelling at 15^{o}C until analysis. The analysis for chemical composition was carried out according to AOAC (2000) method.

Cost Economics

The total cost of experimental diets per quintal was calculated based on prevailing market rates for kids and feed ingredients. The cost of production per ton of green fodder was taken and the labour cost per minimum wage act of the Government of India was taken into account for the calculation of labour cost required for grazing operations.

Statistical Analysis

The data were subjected to analysis of variance (Snedeker and Cochran, 1989). Correlations between body weight and body measurements were studied using Pearson's formula. The comparison of means of different subgroups was made by Duncan's multiple comparison post hoc tests as using SPSS 25 statistical software. The level of significance was determined at $P<0.05$ described by Kumar (1957).

Results and Discussion

Carcass Characteristics of Kids

On 180th day of the study, three kids from each group were randomly selected and slaughtered to study the effect of rearing systems on carcass characteristics.

Carcass Weight and Dressing Percentage

The carcass characteristics of Mahbubnagar local kids reared in different systems of rearing are presented in Table 1. The mean PSW (kg) of kids in the, G1, G2, and G3 groups were recorded as 23.82±0.03, 20.94±0.02and 19.31±0.14, respectively. The mean EBW (kg) and hot carcass weights (kg) were 19.76±0.15, 16.57±0.03 and 15.21±0.14; 12.43±0.15, 9.84±0.03and 8.55±0.14, respectively in G1, G2 and G3 groups at slaughter. Statistical analysis of the data revealed that significant ($P<0.05$) difference was found between G1 and G2 groups in the mean PSW, EBW and hot carcass weight while G2 and G3 groups had non-significant ($P<0.05$) difference.

The mean dressing percent of kids on PSW and EBW was 52.19±0.65, 46.99±0.15and 43.75±0.30; 62.90±0.29, 59.38±0.07 and 56.41±0.28, respectively in G1, G2 and G3 groups. The dressing percentage of the kids had significant ($P<0.05$) difference between G1 and G3 groups while there was no-significant ($P<0.05$) difference between the G2 and G3 groups. EBW was significant difference G1, G2 and G3 among the group.

The PSW, EBW and hot carcass weight of kids were significantly ($P<0.05$) higher in the G1 group followed by G2 and G3 groups. The means of G2 and G3 group kids were comparable. The higher pre-slaughter weight in intensively reared kids was due to higher growth rates than in semi-intensive and extensively reared kids.

The dressing percentage of kids on PSW and EBW was significantly ($P<0.05$) higher in the G1 group than G2 and G3 groups. Agnihotri *et al.* (2006), Rajkumar *et al.* (2010), Alexandre *et al.* (2010), and Das and Rajkumar (2010) studies are in agreement with the present study. While lower findings were reported by Shinde *et al.* (2000) [32] and Karthik *et al.* (2017) [18], whereas Herrera *et al.* (2011) [13] reported contrast findings to the present study. Whereas Sivakumar (2013) observed that the dr essing percentage significantly increased with an increase in pre-slaughter weight. Non-significant differences were observed compared to the present study by Alkass *et al.* (2014) [3] and Marques *et al.* (2014) [23].

Table 1: Carcass characteristics of Mahbubnagar local kids in different systems of rearing

No	Group	Pre slaughter live weight (kg)	Empty body weight (kg)	Hot carcass weight (kg)	Dressing % (PSW)	Dressing % (EBW)
1	G1	23.82±0.03^{a}	19.76±0.15^{a}	12.43±0.15^{a}	52.19±0.65^{a}	62.90 ±0.29^{a}
2	G2	20.94±0.02^{b}	16.57±0.03^{b}	9.84±0.03^{b}	46.99±0.15^{b}	59.38±0.07^{b}
3	G3	19.31±0.14^{b}	15.21±0.14^{b}	8.55±0.14^{b}	43.75±0.30^{b}	56.41±0.28^{c}

$^{a, b, c}$ means with different superscripts column-wise differ significantly at ($P<0.05$) in Duncan multiple comparisons post-hoc test G1: Intensive system, G2: Semi-intensive system, G3: Extensive system.

Weight of organs on pre-slaughter weight

The weight of organs (kg) in Mahbubnagar local kids in different systems of rearing is presented in Table 3 and Table 4. The mean weight (kg) of edible offal like liver, heart,

spleen and testicle was observed as 0.46±0.01, 0.37±0.01 and 0.48±0.05, 0.12±0.02, 0.11±0.04 and 0.11±0.02; 0.08±0.02, 0.08±0.01 and 0.09±0.01; 0.22±0.03, 0.18±0.04 and 0.29±0.06, respectively in G1, G2 and G3 group kids. The mean weight (kg) of kidney of the three groups was 0.12±0.01 in all the kids. The total edible offal weight (kg) in groups G1, G2 and G3 was 1.00±0.06, 0.86±0.02 and 1.09±0.01 respectively and there was non-significant difference between the groups in the edible offal and total edible offal weight.

The mean weight (kg) of lungs, stomach, intestines, blood and head and legs were 0.64±0.03, 0.60±0.04 and 0.57±0.02; 1.51±0.06, 1.73±0. 01 and 1.85±0.05; 0.80±0.04, 0.81±0.05 and 0.89±0.03; 0.61± 0.02, 0.65±0.02 and 0.76±0.07; 2.23±0.04, 2.30±0.09 and 2.0 6±0.06, respectively in G1, G2 and G3 groups. The mean weight (kg) of skin was significantly (P<0.05) higher in the G3 (2.10±0.00) group than G1 (1.75±0.01) and G2 (1.70±0.01) group. The total nonedible offal weight (kg) was higher in G3 (8.23±0.01) than in G1 (7.54±0.07) and G2 (7.79 ±0.01) groups and significant difference was not observed between the three groups in the present the study.

The weight of edible and non-edible organs of kids reared in G1, G2, and G3 groups were similar except for the weight of skin. The weight of the skin was significantly (P<0.05) higher in the G3 group than G2 and G3 groups. A similar weight of edible and non-edible organs was observed by Sureshkumar *et al.* (2010) [35], Kochewad *et al.* (2018) [19], and Ekambaram *et al.* (2012) [11]. Contrast findings were reported by Chaudhary *et al.* (2015) [5], Paramasivam *et al.* (2002) [27] Prasad and Sinha (1991) [28] and Karim *et al.* (2007) [17] supplemented kids had improved organ weight compared to the present study.

Chemical Composition of Meat

The composition of meat (Longissimus dorsi muscle) in kids reared in different systems of rearing is presented in Table 2. The moisture (%) of Longissimus dorsi muscle in G1, G2 and G3 group was 74.60±0.17, 74.70±0.47, and 75.34±0.49, respectively and observed non-significant difference between the groups. The crude protein (%) of meat was higher in the G1 (21.36±0.24) followed by G2 (20.78±0.09) and G3 (20.23±0.23) group. The ether extract (%) of meat in G3 group was lower than G2 andG1 group. The ash (%) of meat was 1.72±0.06, 1.51±0.13, and 1.48±0.04, respectively in G1, G2 and G3groups. The crude protein, ether extract and ash percentage of meat had non-significant difference between the three groups.

Carcass composition is an important aspect of meat quality and is normally assessed by the amount of physically dissected tissues (muscle, fat, and bones) or chemical analysed constituents i.e., protein, fat, water, and ash (Moran and Wood, 1986). The moisture (%) of longissimus dorsi muscle in G1, G2, and G3 groups did not differ significantly. Similar results were observed by Mule *et al.* (2013) and Jalajakshi *et al.* (2016) [15]. The crude protein (%) of meat in the G1 group was slightly higher than G2 and G3 groups, similar findings of crude protein in meat were reported by Shija *et al.* (2013) [31] and Gomes *et al.* (2011) [12]. While Jalajakshi *et al.* (2016) [15] observed lower values compared to the present study.

The ether extract (%) of meat in the G3 group was non significantly lower followed by G1 and G2 groups (Table 4.31). The results of the present study were in agreement with Jalajakshi *et al.* (2016) [15] and Omer and Ekhlas (2018) [25]. The values of ether extract (%) of the present finding were higher than Shija *et al.* (2013) [31] and lower than Gomes *et al.* (2011) [12]. The ash (%) of meat in the present study was within the range observed by Gomes *et al.* (2011) [12] and Omer and Ekhlas (2018) [25], whereas a higher finding was reported by Jalajakshi *et al.* (2016) [15] and Shija *et al.* (2013) [31].

Cost Economics of Kids Rearing

The cost economics of kids in different systems of rearing is presented in Table 5 and Fig 1. The expenditure on the cost of animal, labour and water and electricity was similar in all the three groups. The expenditure on concentrate feed in the G1 and G2 group was □ 9500 and □ 6100, respectively. The cost of veterinary aid was higher in G2 and G3 groups than in the G1 group. The total expenditure towards the rearing of animals in G1 (81550) was higher than in the G2 (74240) and G3 (68200) group.

The income (Rs.) obtained by the sale of animals in G1, G2 and G3 group was 108000, 96000 and 84000, respectively and the corresponding values for the sale of manure were 4000, 2000 and 1000. The gross income (Rs.) was higher in G1 group than G2 and G3groups. The net income (Rs.) obtained from each kid was 2537, 1980, and 1400 respectively in the G1, G2, and G3 groups. The cost per kilogram live weight gain was higher in the G1 group followed by G2 and G3 group.

The cost of animals, labour, water and electricity was the same in the three groups. The cost of animals was highest in the three groups followed by the cost of labour. The cost of concentrate feed was higher in the G1 group than the G2 group because, in the G1 group, the kids were provided with concentrate @ 1 percent body weight. The cost of veterinary aid was the same in the G2 and G3 groups and higher than G1 group because in G2 and G3 groups deworming was done two times more than in the G1 group. The cost of recurring expenditure was higher in the G1 group followed by G2 and G3 groups. These results were in agreement with Porwal *et al.* (2006) [17] and Devendran *et al.* (2012) [10].

The majority of income is through the sale of kids in all three systems of rearing. The income from the sale of manure was higher in the G1 group than G2 and G3 groups because kids are in the sheds throughout the day. The gross and net income was higher in the G1 group followed by G2 and G3 groups. Similar results compared to the present study were reported by Chelapandiah and Balachandraw (2003) [6], Pankaj *et al.* (2010) [26], and Mahanthesh *et al.* (2019) [22]. The cost of per kg live weight was highest in the G1 group than G2 and G3 groups because of concentrate feed and fodder costs. Similar findings compared to the present study were reported by Patil *et al.* (2014). Contrast findings compared to the present study were reported by Shivakumara and Kiran (2019) [33], Christy *et al.* (2019) [8], Legesse *et al.* (2005) [21], and Islam *et al.* (2009) [14]. It could be assumed from the present study that better feeding with improved management might be beneficial and profitable for the goat keepers.

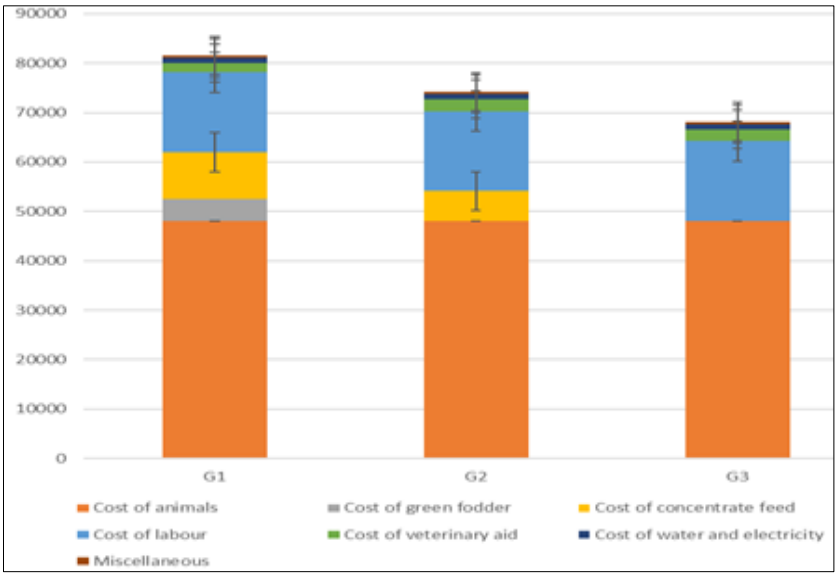

Fig 1: Cost economics of growing kids in different systems of rearing

Table 2: Composition of meat (Longissimus Dorsi muscle) in different systems of Rearing

Sr. No.	Group	N	Moisture (%)	Crude Protein (%)	Ether extract (%)	Ash (%)
1.	G1	3	74.60±0.17	21.36±0.24	2.83±0.15	1.72±0.06
2.	G2	3	74.70±0.47	20.78±0.09	2.71±0.06	1.51±0.13
3.	G3	3	75.34±0.49	20.23±0.23	2.45±0.35	1.48±0.04
G1: Intensive system, G2: Semi-intensive system, G3: Extensive system						

Table 3: Weight of organs (kg) edible offal in Mahbubnagar local kids in different systems of rearing

SR. No	Group	Edible offal (kg)					
		Liver	Heart	Kidney	Spleen	Testicles	Total edible organ
1	G1	0.46±0.01	0.12±0.02	0.12±0.01	0.08±0.02	0.22±0.03	1.00±0.06
2	G2	0.37±0.01	0.11±0.04	0.12±0.01	0.08±0.01	0.18±0.04	0.86±0.02
3	G3	0.48±0.05	0.11±0.02	0.12±0.01	0.09±0.01	0.29±0.06	1.09±0.01

Means within a column having different superscripts differ significantly at ($P < 0.05$) in Duncan multiple comparisons post-hoc test G1: Intensive systemG2: Semi-intensive system G3: Extensive system.

Table 4: Weight of organs (kg) non-edible offal in Mahbubnagar local kids in different systems of rearing

SR. No	Group	Non-edible offal (kg)						
		Lung	Stomach	Intestine	Blood	Skin	Head and legs	Total inedible
1	G1	0.64±0.03	1.51±0.06	0.80±0.04	0.61±0.02	1.75±0.01[a]	2.23±0.04	7.54±0.07
2	G2	0.60±0.04	1.73±0.01	0.81±0.05	0.65±0.02	1.70±0.01[a]	2.30±0.09	7.79±0.01
3	G3	0.57±0.02	1.85±0.05	0.89±0.03	0.76±0.07	2.10±0.04[b]	2.06±0.06	8.23±0.01

Means within a column having different superscripts differ significantly at ($P < 0.05$) in Duncan multiple comparisons post-hoc test G1: Intensive systemG2: Semi-intensive system G3: Extensive system.

Table 5: Cost economics of Mahbubnagar local kids in different systems of rearing

Particulars	G1	G2	G3
Expenditure			
Cost of animals	48000	48000	48000
Cost of green fodder	4500	-	-
Cost of concentrate feed	9500	6100	-
Cost of labour	16200	16200	16200
Cost of veterinary aid	1850	2440	2440
Cost of water and electricity	1000	1000	1000
Miscellaneous	500	500	500
Total expenditure	81550	74240	68200
Total recurring expenditure/kid	2796	2186	1683
Income			
Sale/value of kids	108000	96000	84000
Sale of manure	4000	2000	1000
Gross income	112000	98000	85000

Net income	30450	23760	16800
Net income /kid	2537	1980	1400
Cost /each live weight gain	282	220	156
Benefit-cost ratio	1.37:1	1.30:1	1.24:1
G1: Intensive system, G2: Semi-intensive system, G3: Extensive system			

Conclusion
Different systems of rearing significant impact on carcass characteristics and the intensive system of rearing, the cost of inputs and profit was higher than in semi-intensive and extensive rearing systems and in view of constraints in grazing land propagation of intensive system is the present need.

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Declaration of Conflicting Interests
The authors have no conflict of interest to declare.

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