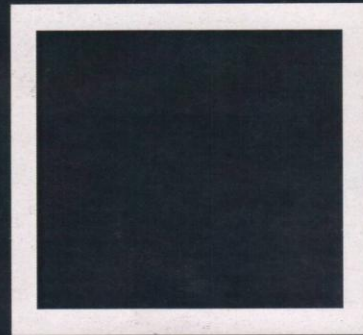


MALABARI GOAT OF KERALA

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1.Introduction

The State of Kerala is popularly known as the “Gateway of South West monsoon” over India. It is a strip of land running in North–South direction, situated between the Arabian Sea and the Western Ghats. Kerala agriculture is mainly dominated by small, marginal and homestead farmers, the average land holding size are small with 10-20 cents (Economics and Statistics, 2009). Agriculture and allied sectors provide livelihood to approximately two-third of the population and contribute 25% of the SDP, of which 40% is contributed by livestock sector. According to the livestock census 2012, the goat population in Kerala is 12.46 lakhs, next to cattle with 13.29 lakhs. Malabari and Attappaddy Black are the two native goat breeds of Kerala. Malabari is medium sized, dual purpose goat known for high prolificacy, milk yield, excellent growth rate and adaptability to hot humid conditions in the state. This breed is also known as Tellicherry goat. Malabari is considered as a supreme breed of Southern peninsular India. It is supposed to be evolved centuries ago by crossing the native feral goats with Arab, Surti and Mesopotamian goats.

2.Goat population in Kerala

The total goat population in Kerala is 12.46 lakhs (19thQuinquennial Livestock Census) and constitutes 43.90% of the farm animals, next to cattle (51%). Nearly 60 % of animals (7.47 lakhs) in the state are supposed to be considered as Malabari breed or graded Malabari. Malabari home tract has a goat population of 2.44 lakhs. The density of Goat Population in Kerala is 32/sq km and the male female ratio 1:2.99 (2985 female goats/ 1000 male goats).

3. Contribution of goats to economy of Kerala

Nearly 4 lakhs families are rearing goat in the state and are benefitted directly by this species, mostly they are land less labour, marginal and small farmers or deprived people. It is not easy to account their contribution in terms of sustaining the livelihood. Production of goat meat is 18,935 Metric tons and accounts for 7.8% of the total meat production in the State. The share of goat milk in the year 2011-12 is 3.9% (1.07 lakh tons) out of the total milk production of 27.17 lakh tones in the State (Integrated Sample Survey, 2011-12).

4.Origin and distribution:

The Kerala coast is referred to as Male by Arab navigators. Albiruni (973 – 1048 AD) is perhaps the first Arab writer to call the place as Malabar. The name is reminiscent of the word ‘Malanadu’ which literally means the hill country. Thus Malabar has taken its name from the hilly or mountainous character of the region. Malabari goats derived their name from the place of origin, Malabar Coast. Malabari breed is distributed mainly in Kannur, Kozhikode or Calicut, Malapuram districts of North Kerala. This breed is also found throughout Kerala, parts of Tamil Nadu and Karnataka. The breeding tract lies at the longitude ranging from 11.15’ to 11.52’ N and latitude 75.25’ to 75.49 E. The home tract of Malabari breed of goat is unique ecosystem with midlands-rolling hills and lowlands-coastal plains, criss-crossed by a network of interconnected brackish canals, lakes, estuaries and rivers known as the backwaters.

Home tract of Malabari Goat (Shaded area)



Fig.1. Home tract of Malabari goat

5.Home Tract

5.1. Physiography of the home tract

The region is broadly divided into three natural divisions, viz. highland, midland and lowland. The lowland with 30-300m MSL stretches along the coastal plain (4-6m MSL) with extensive marshy land and lagoon. The soil in this region is sandy. Coconut tree grows luxuriantly in this area and dominates the landscape. Paddy is also cultivated here. The midlands between 300 and 600m MSL, sandwiched between the lowland and highland. In this region soil is laterite. The valleys broken intermittently by isolated hills and also plains leading to the forest clad uplands. The region is rich in agriculture produce, paddy, tapioca, spices and the cashew being the most important crop. Highlands are between 600 and 2500m MSL. The Pepper, rubber, ginger and turmeric flourish in the lower ranges and tea, coffee and cardamom in the higher elevations.

There are 23 small rivers are flowing towards Arabian Sea in the Malabar region, prominent rivers are Baharathapuzha (209km), Bepore or Chaliyar (169km), Kadalundi (130km), Valapattanam (110 km) and Kuppam or Payangadi (82km). In addition to rivers, the region has a continuous chain of lagoons and backwaters that run parallel to sea coast and receive water from numerous streams and rivers of the land.

There are four types of soil is commonly seen in the region, Coastal alluvium: sandy brown colour, less fertile seen in coastal belt. Alluvial soil: It is seen in river beds and adjoining land, high in fertility and oranic matter. Laterite: Mainly seen in midland, texture is sandy – sandy loam, acidic in nature, yellowish or reddish brown colour and Hill soil: It is seen in sloppy hills, dark brown or yellowish brown colour, less acidic in nature.

5.2. Climate

Kerala has a humid tropical climate influenced by the seasonal heavy rains over 3000mm with 130-140 rainy days per year. Around 65% of the rainfall occurs from June to August corresponding to the Southwest monsoon and the rest from September to December corresponding to Northeast monsoon. The mean daily temperature ranges from 19.8 °C to 36.7 °C. Mean annual temperatures range from 25.0–27.5 °C in the coastal lowlands to 20.0–22.5 °C in the eastern highlands. There are four seasons Pre-monsoon (March–May), Southwest monsoon (June–September), Post-monsoon (October– November) and winter (December–February).

Table 1. Mean climatic parameters

Parameters	Mean Value	Peak month
Minimum Temperature (°C)	23.0	January
Maximum Temperature (°C)	32.5	March
Relative humidity AM (%)	88	July

Relative humidity PM (%)	58	July
Relative humidity Mean (%)	73.0	July
Rain fall (mm)	3045	July
Rainy days (days)	115	June
Evaporation (mm)	136.10	January
Sunshine (hours /day)	6.70	February
Wind speed (km/hr)	3.8	January

5.3. Socio-economic status of goat farmers

Goat rearing is a low input production system in Kerala and is dominated by small and marginal farmers. The 90% of the goat farmers are having land holding less than 30 cents. The participation of women in goat production is about 65%. The average flock size is around 4.10. More than 50% of the goat farmers rear backyard chicken and about 5.15% goat farmers also rear 1-2 cows. Less than 1% farmers are cultivating fodder, of this 99.12% are intercropped fodder plants in coconut gardens.

6. Goat production systems

6.1. Homestead farming system

This production system accommodates nearly 85% of the goat population of the state. The land holding is less than 30 cents and goat flock size is 4-6. It includes number of components like coconut, banana, cashew, mango, rubber and jack. Mostly goats are tethered to a tree or peg to browse for 3-4 hours a day on home garden or seasonally fallow cropland. Household by products like rice gruel, vegetable leftover along with deoiled coconut cake, rice bran are fed and the animals receive minimum health care.



Fig. 2 Homestead farm

6.2. Semi intensive system

This production system accommodates nearly 18-19% of the goat population with flock size of 15-20 goats. Animals are allowed to browse in the community land / coconut/areca nut/cashew/rubber plantations/ range lands /paddy fields for 4-5 hours daily. They are also complemented with little amount of concentrate feed.



Fig.3. Semi-intensive farm

6.3. Intensive system

This system accounts for less than 0.5% with flock size of 35-40 goats, especially for meat production. Recently, many progressive farmers / entrepreneurs have started intensive goat production units. Goats are kept in shelter for most part of the day and led out in the yard during cleaning of pens. Animals are chiefly fed on concentrate feed (70%) and greens (30%) like hybrid napier grass, guinea grass and tree leaves.



Fig.4. Intensive farm

6.4. Feed and fodder resources

The major feed resources comprise crop by-products, straws, brans, weeds and roadside pastures. The common succulent fodder trees are Jack tree, drum stick, tamarind, gliricidia, *Erythrina indica* –Muruku, etc. and cultivated fodder grasses like guinea, hybridnapier, guinea grass, congo-signal and cow pea are also fed to goats. Mangroves are often used as pastures in the home tract.. Farmers feed horse gram, rice gruel, jower, deoiled coconut cake, ground nut cake, rice/wheat bran along with which commercial goat/cattle/ calf feed is also supplemented. Unconventional feeds such as dried tapioca leaf, tamarind seed, rubber seed cake and tapioca starch waste are used as fillers.



Fig.5. Unconventional feed stuffs



Fig. 6. Homemade compound feed

6.5.Housing

Goat shelters are constructed with elevated floor made of wooden/palm/areca/bamboo/fiber platform to avoid dampness. Asbestos or roof sheet/clay tiles are used as roof material, very limited extend thatched coconut leaves are also used.



Fig.7. Coconut tree floor



Fig.8. Plastic slated floor



Fig. 9. Wooden plank floor with tin sheet



Fig.10. Tiled roof



Fig.11. Asbestos roof



Fig. 12. Coconut palm leaf roof

6.6. Breeding

Breeding is done by natural service or AI in veterinary dispensaries. Bucks are generally purchased from nearby farmers or supplied by AICRP unit. About 61 per cent of people pay for natural service (@Rs.150-200/- service) and 56.40% have to travel below 2 km only for getting their animals. About 30 % of farmers are maintaining breeding males.

6.7. Marketing

Farmers sell their kids to other farmers or to traders. Self help groups are also organizing goat fair to sell the animals every month or as per the demand. The rate varies from Rs.290-320/kg in organized market of SHG. Milk is used for family consumption or sold to households or ayurveda medicine preparing units @Rs.40/lit.



7. Breed characteristics

7.1. Physical Characters

7.1.1. Body colour

Malabari goats are mainly white, white and black or white and brown. The colour of skin is pink or black or white or brown. Forehead is white or black. Muzzle is generally black and majority of animals have white colour on chest, both sides of abdomen and at hindquarters.

7.1.2. Forehead

Nearly two third animals has convex forehead one third animals has concave forehead. Tassels are present in 12% animals . All the males are bearded and less than 10% females also bearded. The mean face length is ranged from 17 to 23.5cm with mean of 20.71 ± 0.34

7.1.3. Ear

Ear colour was black, brown or white, the orientation is horizontal (55%) or drooping (40%) or erect (5%) . Average ear length was 14.59 ± 0.07 cms.

7.1.4. Hair pattern

Hair is straight, curly hair was a rare phenomenon in Malabari. Two third of animals had glossy hair. Tuft of hair is present in the forequarters, mostly short hair (57%) followed by medium (37%) and long (6%). Animals has long or short hair pattern in hind quarters.

7.1.5. Horn pattern

Nearly 85% of all animals are horned. Average horn length was 9.25 ± 0.102 cm. Lateral and backward pointing tips are more commonly seen. Upward /Inward pointing tips are also seen small proportion of animals. Horns are straight (75%) or curved (29%).

7.1.6. Udder

All udder shapes like round, pendulous, bowel and troughl are generally seen, though round udder is more common. The teat is funnel or cylindrical shaped. Pointed teat is more common than round teat. The average teat length is 6.53 ± 0.36 in adult does.

7.2. Body confirmation

Medium-sized animals. Coat colour varies widely from completely white to completely black. Males and a small percentage of females (6.25%) are bearded. Both sexes have small, slightly twisted, horns, directed outward and upward. Ears are medium-sized, directed outward and downward, ear length: 16.30 ± 0.20 cm. Tail is small and thin; tail length: 13.10 ± 0.05 cm. Udder is small and round with medium-sized teats.

7.3. Flock structure

The average flock size ranged from as low as 1 animal to a maximum of 50 numbers are maintained by farmers in the home tract. The average flock size is 4.5, less than 23% of farmers are rearing five or more number of animals. About 65% of farmers do not maintain breeding male.

7.4. Body weight

The least square means of body weight at different ages and type of birth are presented in Table 1. The overall weight at birth weight, 3, 6, 9, 12 and above 24 months were 1.83 ± 0.05 , 8.75 ± 0.35 , 15.40 ± 0.57 , 20.20 ± 1.25 , 24.30 ± 2.10 and 34.40 ± 2.20 , respectively.

Table 2. **Body weight of Malabari goat at different ages and birth type**

Age	Body wt (kg)			Type of birth		
	M	F	Over all	Single	Twin	Triplet
Birth	1.82 ± 0.05	1.79 ± 0.06	1.83 ± 0.05	1.85 ± 0.07	1.66 ± 0.09	1.34 ± 0.12
3 months	9.26 ± 0.36	8.20 ± 0.35	8.75 ± 0.35	8.53 ± 0.38	7.46 ± 0.39	6.22 ± 0.31
6 months	16.3 ± 0.57	14.46 ± 0.57	15.40 ± 0.57	15.40 ± 0.55	14.17 ± 0.56	12.86 ± 0.54
9 months	20.8 ± 1.19	19.57 ± 1.04	20.20 ± 1.15	20.20 ± 0.25	18.90 ± 0.26	17.96 ± 0.44

12 months	24.70 ± 2.36	23.94 ± 1.75	24.30±2.10	23.87±.64	23.70±0.69	23.34±1.76
24 months and above	38.50 ± 1.75	30.50 ±2.36	34.40±2.20	34.66± 2.50	34.28± 2.39	34.20± 2.30

7.5. Body measurements

The means of body measurements like chest girth, body length and height at withers are presented in Table 3.

Table 3. Body measurements at different ages

Age	Chest girth (cm)		Body Length (cm)		Height at wither (cm)	
	Male	Female	Male	Female	Male	Female
Birth	34.66±0.32	34.38±0.32	32.05±0.30	31.73±0.30	35.18±0.31	34.86±0.31
3 months	47.09±0.32	46.61±0.31	43.68±0.31	43.31±0.30	47.11±0.34	46.69±0.33
6 months	56.60±0.41	55.56±0.41	52.88±0.46	52.43±0.46	55.97±0.42	55.11±0.42
9 months	62.67±0.60	62.16±0.58	56.73±0.66	56.72±0.64	60.91±0.67	59.84±0.66
12 months	65.62±1.61	66.51±1.54	60.63±1.03	59.59±0.99	63.43±1.72	61.63±1.67
24 months and above	71.62±1.61	63.51±1.54	70.63±1.03	62.59±0.99	73.43±1.72	66.63±1.67

7.6. Growth rate

Growth rate of Malabari goats at different ages are presented in Table 4. Maximum gain of 78gms/day was obtained during birth to one-month period. Thereafter there was a decline in growth rate up to six months and then a gradual increase of 53 gms/day between nine months and one-year period. As expected, single born animals gained faster. Males gained more than females throughout the period except during nine months to one-year period.

Table 4. Growth rate (g/day) of Malabari goats

Factor	Growth Rate (gm) at				
	Birth to 3 months	3-6 months	6-9 months	9-12 months	Overall
Overall mean	77.97	72.87	54.35	42.04	52.79
Sex					
Male	61.67	67.78	52.22	35.56	54.31
Female	56.1	65.56	54.44	25.56	50.42
Type					
Single	88.49	66.67	45.56	45.56	54.45
Twin	74.19	63.33	50.00	43.33	53.89
Triplet	72.22	41.36	38.32	36.50	47.10

8. Population parameters

8.1. Heritability estimates of body weights

The heritability of body weight at different ages is given in Table 5. A higher heritability value of 0.483 ± 0.754 was obtained for body weight at 12 months.

Table 5. Heritability estimates for body weight at different ages of Malabari goats

Age	Heritability	Standard error
Birth weight	0.138	0.217
1 month weight	0.085	0.15
3 month weight	0.340	0.293
6 month weight	0.075	0.263
9 month weight	0.0229	0.380
12 month weight	0.483	0.754

8.2. Genetic and phenotypic correlations.

Genetic and phenotypic correlations between weights at different stages are given in Table 6. From three months onwards the body weights had high genetic and phenotypic correlations with subsequent weights.

Table 6. Genetic and phenotypic correlation between body weights at different stages

Traits	Genetic	Phenotypic
Birth weight - 1 month	0.777±0.311	0.420
“ - 3 months	0.223±0.686	0.323
“ - 6 months	0.241±0.704	0.039
“ - 9 months	0.651±0.718	0.022
“ - 12 months	0.546±1.09	0.177
1 month - 3 months	0.301±0.553	0.492
“ - 6 months	0.567±0.221	0.189
“ - 9 months	0.753±0.254	0.102
3 months - 6 months	0.936±0.13	0.679
“ - 9 months	0.439±0.68	0.517
“ - 12 months	0.756±0.81	0.435
6 months - 9 months	0.778±0.38	0.679
“ - 12 months	0.761±0.505	0.545
9 months - 12 months	0.826±0.278	0.804

8.3. Prediction of trends for Body Weights and milk production

The genetic trend of body weight was highest at three months followed by six months of age. Genetic trend was high for lactation yield.

Table 7. Phenotypic, genetic and environmental trends for Body Weights and milk Production

Trait	Phenotypic	Genetic	Environmental
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3 Months body weight	0.53±0.29	0.82±0.48	-0.29±0.31
6 Months body weight	0.57±0.31	0.62±0.17	-0.05±0.27
9 Months body weight	0.29±0.65	0.42±0.14	-0.13±0.24
12 Months body weight	0.46±0.09	0.21±0.07	0.25±0.05
Lactation Yield	0.074±0.004	0.19±0.13	0.12±0.56

8.4. Prediction of body weight from body measurements.

Body weight was predicted separately from body measurements of girth, length and height (Table 8.) and in combination (Table 9) .

When single measurements were taken the reliability of prediction increased as age advanced, as reflected by high R^2 values. Girth was found to be more reliable in predicting the body weight than length and height.

Girth combined with height or length were found to be better when two measurements were taken. The predictions were more reliable at later ages. All three measurements taken together were found to be most reliable.

Table 8. Prediction of body weight from body measurements (girth, length and height)

Age	Girth		Length		Height	
	Equation	R ² %	Equation	R ² %	Equation	R ² %
1 month	-4.297+0.24x	37	-3.53+0.23x	35	- 1.42+0.15x	16
3 month	-6.58+0.31x	60	-4.91+0.29x	39	- 7.53+0.30x	44
6 month	-7.59+0.35x	52	-3.40+0.308x	31	- 8.22+0.38x	43
9months	- 21.46+0.633x	74	-18.1+0.67x	62	- 20.12+0.65 x	66
1 year	-26.45+0.72x	70	-19.34 + 0.69x	54	18.70 +0.63x	63

Table 9. Prediction of body weight from combinations of body measurements

Age	Girth & height		Length & Girth		Length & height		Length, girth & height	
	Equation	R ² %	Equation	R ² %	Equation	R ² %	Equation	R ² %
1 month	-4.46+0.23x ₁ + 0.012x ₂	37	- 4.74+0.12x ₁ +0.16x ₂	40	- 3.87+0.021x ₁ +0.02x ₂	35	- 4.67+0.114x ₁ +0.15x ₂ - 0.006x ₃	40

3 months	$-8.5+0.25x_1 + 0.105x_2$	62	$7.18+0.05x_1 +0.28x_2$	60	$- 8.8+0.15x_1+0.22x_2$	49	$- 8.61+0.018x_1+0.24x_2+0.09x_3$	62
6 months	$- 12.63+0.25x_1+ 0.105x_2$	60	$- 9.78+0.12x_1 +0.29x_2$	55	$- 9.68+0.136x_1 +0.286x_2$	46	$- 12.86+0.04x_1+0.24x_2+0.19x_3$	61
9 months	$- 26.16+0.42x_1+ 0.32x_2$	82	$- 24.34+0.27x_1+0.46x_2$	78	$- 22.9+0.325x_1 +0.411x_2$	72	$- 26.57+0.102x_1+0.38x_2+0.27x_3$	82
1 year	$- 26.16+0.53x_1+ 0.20x_2$	72	$- 28.4+0.21x_1 +0.58x_2$	73	$- 23.36+0.30x_1 +0.45x_2$	68	$- 27.95+0.18x_1+0.46x_2+0.15x_3$	73

8.5 Age weight relationship

Biweekly bodyweights up to 48 weeks were taken to predict age weight relationship. Seven equations were fitted (Table 10). The equation $Y = 1.73(1.00)^{1/x} x^{0.57}$ was found to be best fitting one for prediction of body weight (in kg) in Malabari goats based on age at weekly intervals with an R^2 value of 99.2%.

Table 10. Age weight relationship of Malabari goats

No.	Equation	R^2 value %
1	$Y = 2.99 + 0.286x$	96.8
2	$Y = 3.23 + 0.278x - 0.00015/x$	97.2
3	$Y = 2.44 + 0.358 x - 0.0015 x^2$	97.1
4	$Y = 3.68 (1.03^x) (x^{0.094})$	95.0
5	$Y = 1.73(1.00)^{1/x} x^{0.57}$	99.2
6	$Y = 14.77(e^{[(x-42.21)/2]})$	94.18
7	$5.18(x/38.36)^{0.09} e^{(x/38.36)}$	94.98

Inside an equation ^ denotes exponentiation

x = age in weeks

e = 2.7183

9.Reproduction

9.1. Female

The reproductive performance of malabari goats are presented in the table 11. The age first kidding was highly variables. Females are allowed to breed before attaining body weight 15kg. The inter-kidding interval was lowered as parity advanced

Table 11. Reproduction performance

S. No	Traits	Mean \pm SE
1	Age at first oestrous (months)	7.10 \pm 0.02
2	Age at first mating (months)	8.34 \pm 1.15
3	Age at first kidding (days)	12.98 \pm 1.40
4	Weight at first mating (kg)	18.20 \pm 2.30
5	Kidding Interval (days)	9.19 \pm 0.40
6	Service Period (days)	129.20 \pm 10.10
7	Gestation Period (days)	149.10 \pm 0.20

9.1.1. Reproductive efficiency

The breed is quite prolific and has a 53% multiple births and the kidding percentage is 164.36 % in the field condition (Table 12.)

Table 12. Incidence of multiple birth in Malabari goats

	Farm		Field	
	No.	Percentage	No.	Percentage
Singles	267	56.45	2027	47.95
Twins	181	38.27	1923	45.62
Triplet	17	3.59	255	6.03
Quadruplet	8	1.69	17	0.4
Total	473	100	4228	100

Table 13. Average number of kids per kidding

No. of kidding	No. of kids
1 st kidding	1.16 \pm 0.05 (98)
2 nd kidding	1.27 \pm 0.05 (86)
3 rd kidding	1.42 \pm 0.07 (62)
4 th kidding	1.40 \pm 0.09 (45)
5 th kidding	1.50 \pm 0.11(32)
6 th kidding	1.52 \pm 0.10 (21)
Overall average under farm conditions	1.41 \pm 0.03 (323)
Overall average under field conditions	1.70 \pm 0.10 (205)

Table 14. Inter-kidding Interval in Malabari goats

Kidding	Mean	No.
1 and 2	346.51 \pm 9.42	93
2 and 3	315.89 \pm 10.22	84
3 and 4	308.95 \pm 11.64	58
4 and 5	306.84 \pm 16.91	45
5 and 6	286.93 \pm 18.89	24
6 and 7	297.31 \pm 31.11	18
7 and 8	252.00 \pm 60.00	9

9.1.2. Incidence of reproductive problems

The incidence of reproductive problems is rare in Malabari breed. The incidence of still birth, abortion, dystocia and retention of foetal membranes were 1.61% , 1.18%, 1.60% and 0.58%, respectively. Reproductive problems is more common in the first kidding (65%) than subsequent kidding.

9.2. Male Reproduction

The semen attributes of Malabari bucks are presented in the table 15

Table 15 Physical attributes of semen in malabari bucks

Attributes	Mean \pm SE
Reaction time	49.37 \pm 2.45 sec
Colour	creamy with a yellowish tinge
Volume	1.25 \pm 0.3 ml
p ^H	6.89 \pm 0.21
Motility (%)	82.77 \pm 1.33
Sperm viability (%)	90.14 \pm 0.53
Abnormality (%)	2.28 \pm 0.12
Sperm concentration (millions/ml)	2781.82 \pm 51.69

10. Milk Production traits

The average lactation length and dry period are presented in Table 16. The peak yield reported was 808.63 \pm 21.23 ml. Generally farmers began using milk seven days after kidding and animals were milked up to 5 months. 38% of farmers did not milk the animals, but allowed kids to suckle, and 50% milked animals for a few weeks only. 92% of farmers washed the udder before milking and 95% cleaned milking utensils regularly.

Table 16. Average milk yield, lactation length and dry period in Malabari goats

Trait	Average \pm S.E.	No.
Early lactation yield (ml)	820 \pm 13	1046
Mid lactation yield (ml)	670 \pm 16	441
Late lactation yield (ml)	560 \pm 24	443
Total lactation yield	850 \pm 30	
Peak yield (ml)	1237.62 \pm 75.44	579
Lactation Length (month)	5.33 \pm 0.470	398
Dry period (month)	4.51 \pm 0.32	249

10.1. Milk Composition

Malabari goat milk is believed to be easily digestible and good for infants, old and convalescent people. About 70 % fat globules are reported to be less than 3 μ . and mean size is 2.64 μ . Goat milk used as an important ingredient in the ayurvedic medicines and medicated oils. The goat milk is sold at Rs.40 to 100 depends upon demand and area.

Table 17. Milk composition in Malabari goats

Milk constituents	Mean
Specific gravity at 60° F	1.034
Water	84.88 %
Total solids	14.62%
Total protein	4.05%
Fat	4.95%
Lactose	5.09%
Ash	0.76%
Solid not fat (SNF)	9.67%
Casein	3.15
Lactalbumin	0.613
Calcium	167.70 mg/100ml
Phosphorous	102.90 mg/100ml

11. Incidence of diseases in Malabari goats

The common diseases affecting Malabari goats are enteritis (37%), Pneumonia (24.22%), Coccidiosis (13.04%), Acidosis (11.20%), tympany (8.07%) and Polyencephalomyelitis (6.83).

Mortality

The overall monthly rate was found to be 9.89%. Kid: 11.6% ; adults: 4.0% , Enteritis and Pneumonia are the major causes of mortality. This was 10.9% for males and 8.7% for females.

12. Physiological Parameters

12.1. Haematology

The different haematological and blood biochemical values are presented in the table 18 & 19.

Table 18. Blood Parameters in Malabari goats

Parameter	Mean±SE
Total WBC (thousan/cumm)	9.27±1.10
Lymphocytes (%)	26.30±6.43
Monocytes (%)	7.50±2.47
Granulaocytes (%)	69.27±9.10
Haemoglobin (gm %)	9.17±0.11
Packed Cell Volume (%)	26.17±0.87
Total Erythrocyte count (*10 ⁶ /ml)	12.56±-0.63
MCV((fL))	20.93±0.51
MCH (pg)	7.37±0.31
MCHC (g %)	35.16±0.80

Table 19. Blood biochemical values in Malabari goat

Parameter	Mean±SE
Albumin (g/dl)	3.16±0.18
Globulin (g.dl)	3.47±0.35
Urea(mg/dl)	98.79±9.48
Creatinine (mg/dl)	0.64±0.05

Glucose (mg/dl)	62.54±4.36
Cholesterol	72.83±4.46
Total protein (g/dl)	6.57±0.38
Calcium	14.14±0.79
Phosphorus	8.18±0.39
Zinc	7.87±0.65
Copper	0.87±0.03
Selenium	1.15±0.24

12.2. Body Temperature, Respiration and Heart rate

The body temperature, respiration rate and heart rate was high in kids followed by adult males (Table 19)

Table 19 Mean Body Temperature, Respiration and Heart rate

Parameter	Male	Female	Kids
Body Temperature (°F)	100 ±0.3	100±0.3	101±0.4
Respiration rate/min	32±0.2	30±0.2	75±0.9
Heart rate/min	78±0	64±0	98.5±1.1

13. Biochemical polymorphism

13.1. Blood Proteins

The genotype and gene frequencies for different blood protein variants are presented in table 20.

Table 20. Gene and genotype frequencies of haemoglobin and transferrin

Protein variant	Genotype frequencies	Gene frequencies
Haemoglobin	AA-97.6890	A-0.9867
	AB-1.980	
	BB-0.3333	B-0.0133
Transferrin	AA-0.99	A-0.9867
	AB-0.10	
	BB-0.3333	B-0.0133

13.2. Milk Protein Polymorphism

Milk Protein variants such as α_1 -casein, β -casein, Kappa casein, α -lactalbumin and β -lacto globulin were documented (Raja,1997) and results are presented in table.

Table 21. Genotype and gene frequency of milk protein variants in Malabari goats.

Protein Variant	Phenotype Frequency	Gene frequency
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Alpha s1 casein	FF-0.20 FS-0.56 SS-0.24	F-0.48 S-0.52
Alpha S2 casein	AA-0.40 AB-0.44 BB-0.16	A-0.62 B-0.38
Beta Casein	AA-0.18 AB-0.54 BB-0.28	A-0.45 B-0.55
K-casein	AA-0.44 AB-0.48 BB-0.08	A-0.68 B-0.32
Betalacto globulin	AA-0.44 AB-0.42 BB-0.14	A-0.65 B-0.35

14. Meat quality of Malabari Goat

The factors like colour, pH, water-holding capacity and intramuscular fat are important attributes to determine quality of meat. Meat is reddish in colour. All parts of the body except hoof and horn is consumed in Kerala. Boti is a very popular product in Kerala made from stomach and intestine of goat. The physico-chemical properties and fatty acid profile of meat of malabari goat are presented in Table 22 & 23. The sensory attributes appearance and colour, flavour, juiciness, tenderness, binding and overall acceptability was evaluated on eight point descriptive scale as suggested by Keeton (1983). The sensory score of 8 was extremely desirable, whereas a score of 1 was extremely undesirable (Table 24).

Table 22. Physico-chemical properties and on meat quality in Malabari goat

Parameter		Mean
Moisture (%)		10.45±2.46
Crude protein (%)		71.38±2.40
Crude Fibre (%)		0.30±0.04
Ether extract (%)		14.36±2.11
Total Ash (%)		4.03±0.18
Gross energy (Kcal/Kg)		5412.06±176.33
Meat pH Immediate		6.76
Meat pH after 24 hrs		5.87
Meat (Kg)		6.9
Dressing (%)		34.85
Cooking loss (%)		26.51
Drip loss (%)		1.58
Colour	L	42.67
	a*	16.78
	b*	13.59
Colour after 24 hrs	L	46.79
	a*	17.27
	b*	15.48

L* indicates lightness, varies from 0-100 and when L is negative it indicates black.
a* is the red/green coordinate, a is positive which indicates redness and negative means greenness.
b* is the yellow/blue coordinate. Positive value shows yellowness and negative means blueness.
Deltas for L* (ΔL^*), a* (Δa^*) and b* (Δb^*) may be positive (+) or negative (-).

Table 23. Fatty acids profile of meat in Malabari goat

Fatty acids	Mean \pm SE	Type
Myristic Acid (%)	2.66 \pm 0.31	saturated
Palmitic Acid (%)	23.78 \pm 0.63	saturated
Stearic Acid (%)	15.08 \pm 0.80	saturated
oleic Acid (%)	45.62 \pm 1.21	Omega-9
Linoleic Acid (%)	3.68 \pm 0.29	Omega-6
Linolenic Acid (%)	0.49 \pm 0.04	Omega-3
Arachidic Acid (%)	0.23 \pm 0.01	Omega-6
Behenic Acid (%)	0.90 \pm 0.12	
Ecosapentaenoic Acid(%)	0.27 \pm 0.03	Omega-3
Docosahexaenoic Acid (%)	0.26 \pm 0.04	Omega-3
Palmitoleic Acid (%)	4.46 \pm 0.21	
Others (%)	2.62 \pm 0.27	

Table 24. Sensory evaluation of malabari goat meat

Parameter	Malabari
Apperance	5.99
tenderness	6.28
juiciness	5.79
Flavour	5.44
Overall acceptability	6.02
N=6, max score=8	

15.Malabari goat products in Ayurvedic medicines

Malabari goat milk, meat and urine are incorporated in the Ayurvedic medicines for the treatment of different ailments (Table 24).

Table 24. Ayurvedic Medicines prepared by using goat meat, milk and urine.

SI No.	Name of medicine	Goat products included as an Ingredients	Utility
1	Amrithaprasaghritam	Goat Meat	General health
2	Dehaposhanayamakam		
3	Brihachagaladighritam		
4	Ajaswagandhadileham		

5	Mahamashatailam	Goat Milk	Rheumatic complaint
6	Valiyaprasaranitailam		
7	Maharaja prasaranitailam		
8	Vilvadigulika	Goat urine	Treatment for poisoning

16.Future genetic improvement strategy

A long term perspective planning and approach is needed to augment the genetic gain in the Malabari goat. It is necessary to conduct breed wise census to ascertain the exact total population of the breed, also to locate elite germplasm. Indiscriminate crossbreeding with other breeds like Jamunapari, Sirrohi and Boer should not be encouraged in the home tract. Establishment of breed societies or producer companies will be of immense help to coordinate breeding and marketing activities. Goat improvement programmes taken up by different agencies should be linked for maximum output and avoid duplications. Supply of superior bucks or semen to farmers will bring in good breed conformation among decedents.



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