

**STUDY ON UDDER AND TEAT MORPHOLOGY AND ITS
RELATIONSHIP WITH MILK YIELD IN PURNATHADI
BUFFALO**

T H E S I S

Submitted

In partial fulfillment of requirements for the Degree of

MASTER OF VETERINARY SCIENCE

IN

LIVESTOCK PRODUCTION AND MANAGEMENT

BY

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DECLARATION OF STUDENT

I hereby declare that the experimental Research work and interpretation of the thesis entitled “**STUDY ON UDDER AND TEAT MORPHOLOGY AND ITS RELATIONSHIP WITH MILK YIELD IN PURNATHADI BUFFALO**” or part thereof has not been submitted for any other degree or diploma of any University, not the data have been derived from any thesis/publication of any University or scientific organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

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Declaration of Advisory Committee

ALANE PRASHANT SANJAY has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled, **“STUDY ON UDDER AND TEAT MORPHOLOGY AND ITS RELATIONSHIP WITH MILK YIELD IN PURNATHADI BUFFALO”** submitted by him is the result of research work is sufficient to warrant its presentation to the examination in the subject of **LIVESTOCK PRODUCTION AND MANAGEMENT** for the award of **MASTER OF VETERINARY SCIENCE** degree by the Maharashtra Animal and Fishery Sciences University, Nagpur.

We also certify that the thesis or part thereof has not been previously submitted by him for a degree of any other University.

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CERTIFICATE

This is to certify that the thesis entitled, “**STUDY ON UDDER AND TEAT MORPHOLOGY AND ITS RELATIONSHIP WITH MILK YIELD IN PURNATHADI BUFFALO**” submitted by **Mr. ALANE PRASHANT SANJAY** to the Maharashtra Animal and Fishery Sciences University in partial fulfillment of the requirement for the degree of **MASTER OF VETERINARY SCIENCE in LIVESTOCK PRODUCTION AND MANAGEMENT** has been approved by the Student’s Advisory Committee after examination in collaboration with the External Examiner.

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Place: Akola

Date:

(ALANE PRASHANT SANJAY)

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LIST OF ABBREVIATIONS

Abbreviation/Symbols	Full form
%	: Percentage
Ave.	: Average
e.g.	: example
et al.	: And others/ And Association
Fig(s)	: Figures
Kg	: Kilograms
LL	: Lactation Length
LMY	: Lactational Milk Yield
P	: Significant
r	: Correlation
SE	: Standard Error
TDMY	: Test Day Milk Yield



Chapter - I
Introduction

CHAPTER I

INTRODUCTION

Buffalo is a versatile animal that is found worldwide, from tropical to temperate environments and even at elevations of over 7000 feet. The wild water buffalo (*Bubalus arnee*) is most likely the ancestor of domestic water buffalo. Based on morphological and behavioural traits, two varieties of water buffalo are recognised: The water buffalo or Asiatic buffalo or domestic water buffalo or Asian water buffalo (*Bubalus bubalis*), a large bovid that evolved in the Indian subcontinent and Southeast Asia is a buffalo of the Indian subcontinent and farther west to the Balkans, Egypt, and Italy. It is also found in Europe, Australia, North America, South America, and parts of Africa. Another variety is the swamp buffalo, which is found from Assam in the west to the Yangtze valley of China in the east. Based on the findings of phylogenetic analysis, the river-type water buffalo originated in western India. They were domesticated around 6,300 years ago, and the swamp-type water buffalo originated independently from Mainland Southeast Asia and was domesticated between 3,000 and 7,000 years ago.

The Asian economy continues to rely on water buffalo. River buffaloes are primarily dairy animals used for milk and in flooded fields for draught power in India. Buffaloes are recognised for their toughness, proclivity of chewing cud, and increased milk fat content. Despite the smaller population compared with cows, they contribute about 50% to the total milk production of India. Buffaloes are highly adapted to hot and humid climates. Because of their adaptability to the harsh climate, resistance to tropical illnesses, and inadequate management play a vital role in uplifting India's agricultural economy. They are an important source of revenue generation, especially for the poor sectors of rural India's marginal and small farmers, as they digest dry matter and cellulose more efficiently than cattle. Buffalo can easily convert poor quality feed material, e. g. straws, agro-industrial waste by-products into human food, restore soil fertility with organic manure and serve as a financial asset in difficult times. Though buffalo plays a key role in green, white and red

agricultural revolutions, it has sadly been relegated to the background. Previously, it had been overlooked. (Pasha & Hayat 2012).

According to the 20th livestock census of India, the overall livestock population is 535.78 million, showing an increase of 4.6 per cent over the last livestock census (2012). In 2019, the total bovine population (cattle, buffalo, Mithun and yak) was 302.79 million, which shows an increase of 1.0 per cent over the previous census. The total buffaloes in the country are 109.85 million buffalo population in 2019, showing an increase of 1% over the last census (108.70 million). Female buffalo population showed an increase of 8.61%, whereas male buffalo declined by 42.35% over the previous census. The total milch animals (in-milk and dry) in cows and buffaloes are 125.34 million, an increase of 6.0 % over the previous census. Buffaloes contribute about 20.5% of the total livestock. The total female buffalo population of Maharashtra is 52.75 lakh. (20th livestock census).

Purnathadi buffalo, an excellent genetic resource, is one of the strains of Nagpuri buffalo. Other strains are Nagpuri, Gaolao, Shahi, and Ellichpuri (Ali *et al.*, 2020). It is maintained by rural farmers in the western Vidarbha region, and its native home tract includes Akot, Akola, and Telhara tehsils in Akola district; Daryapur, Anjangaon, and Achalpur tehsils in Amravati district; and adjoining villages in Buldhana district. In this region, these animals are found along the bank (*thadi*) of river Purna. Hence this germplasm is named Purnathadi. The river Purna originates in the Satpuda hills and flows through these districts.

The Purnathadi buffalo breeding tract is lies between 20.70° and 21.25° North latitude and 76.84° and 77.77° East longitudes. Summer is extremely hot, and the temperature range is wide; the maximum ever recorded is 47.9°C, and the lowest during the winter is 2.2°C with an average rainfall of 800 mm, and a humidity level of roughly 49.1%.

Purnathadi buffalo has a variety of body coat colours, ranging from pale to light brown. Some newborn calves have a completely white coat that gradually becomes brown as they grow older. Their adaptation to the region's intense heat climate may be due to their light body coat colour. Muzzles are white, reddish, or black. Purnathadi animals are medium-sized, with a high milk fat percentage, good reproductive efficiency, cheap cost of maintenance, and decent acclimatisation to Vidarbha's tough and hot weather (Ali *et al.*, 2019).

Though sufficient information on production pedigree and progeny records of most of the animals in the villages is not available, some criteria about the animal's likely milk production capabilities are currently required. One of the heritable characteristics and key considerations for dairy animals is udder morphology. The size and shape of the udder are crucial conformation factors that might affect the viability of dairy animals for economic milk production. They should be evaluated while choosing dairy animals (Bhuiyan *et al.*, 2004). The average daily milk yield, teat measurements (length, diameter, distance between the front and hind teats) and udder measurements (udder length, udder width, and udder depth) had a positive connection (Prasad *et al.*, 2010). Buffaloes with udders that extended farther forward and backwards were deeper, had a higher rear attachment, and cylindrical shaped teats with cylindrical tips gave more milk (Bhardwaj *et al.*, 2007). Udder length, width, depth, and circumference were also positively correlated with swamp buffalo milk production (Akhtar *et al.*, 1998).

In female animals, udder and teat morphology gives an idea about her supremacy for breeding purposes, attachment, and prominence of milk mirror and milk veins for lactation. In past the research on the udder and teat morphology in Purnathadi buffaloes has not been done extensively. The size and morphology of the udder are supposed to vary considerably from individual to individual animal and among lactation orders. Hence, the present study entitled "Study on Udder and Teat Morphology and its relationship with

milk yield in Purnathadi Buffalo" was undertaken with the following objectives-

Objectives:

- i. To study the udder and teat morphology in Purnathadi buffalo.
- ii. To study the relationship of udder and teat morphology with test day milk yield in Purnathadi buffalo



Chapter - II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

The goal of this study, titled "Study on Udder and Teat Morphology and its Relation with Milk Yield in Purnathadi Buffalo" was to look at the phenotypic and morphometric characteristics of the udder and teat in Purnathadi buffalo in the Akola district in Western Vidharbha region of Maharashtra.

The scientific study on the Purnathadi buffalo is limited, but the findings of the researchers who have published and made their findings available were used to support the conclusions of the current investigation and to strengthen its scientific foundation. Similar studies were carried out on various breeds of buffaloes, and some research on cows was also critically examined to investigate the relationship between udder and teat morphology. Because there is a scarcity of information on buffaloes, information on cows has been reviewed.

During the present research work, total 90 Purnathadi buffaloes were accessed for the measurement of different parameters of udder and teat and milk yield required for the study. The data generated were analyzed statistically and compared with the findings of available research works.

The reviews of the research work and the findings related to udder and teat morphology and its correlation of milk yield in buffaloes are thoroughly analyzed and the available literature is discussed under the following headings in the foregoing pages.

1. Udder morphology in buffaloes
2. Teat morphology in buffaloes
3. Milk yield

Udder Length

Radekar *et al.* (2003) studied on udder measurement traits of Pandharpuri buffaloes. The overall least square mean for udder length were 43.71 ± 0.20 cm.

Bhuiyan *et al.* (2004) conducted an experiment on 100 dairy cows to study importance of mammary system confirmation traits. For recording the data, Length of udder was measured from rear attachment of udder along its sole, where fore udder blends smoothly with body. Udder width was measured by 4 passing over the tape in between fore and rear teats from near of stifle joint on one side to other side.. A visual observation was made to evaluate shape of udder. Statistical analysis such as per cent mean, standard error, coefficient of variation, correlation coefficient were done to get clean picture to correlate the data.

Prasad *et al.* (2010) Studied on the udder measurements as affected by parity in Murrah buffaloes. The mean and S.E values of udder length in the present study in Murrah buffaloes with different parity ranged from 52.21 ± 0.61 cm in 1st parity, 54.55 ± 0.68 cm in 2nd parity, 55.71 ± 0.73 cm in 3rd parity and 54.12 ± 0.73 cm in 4th parity. The overall mean for udder length was 54.16 ± 0.34 cm. there was an increase in udder length from 1st to 3rd lactation.

Lavania *et al.* (2011) Studied on udder measurement traits of 51 Surti buffaloes. The overall least square means for like udder length were 45.0 ± 0.7 cm.

Gubbawar *et al* (2012) revealed that, irrespective of age, the udder length was ranging from 45.00 to 82.50 cm in Gaolao buffaloes with an average length of 55.05 cm Thus, the udder of Gaolao strain of Nagpuri buffalo breed could be considered as medium length.

Yosbanis *et al.* (2013) studied 492 buffaloes of two cattle farm of the occident of Cuba were used; they were among one and 17 lactations, Udder measurements included: depth, length, width, volume, separation, length and diameter of the cranial and caudal teat using rulers, compass and calipers and like measuring unit the centimeter (cm.) It was obtained that the average values in the udder length was 38.46 cms. The udder length showed moderate to high correlations (0.24 to 0.54) with all the production variables. It is concluded that the correlations among the variables for morphological traits evaluated were moderate to high.

Thalkar *et al.* (2016) studied Morphological Characteristics of Purnathadi and Ellichpuri Strain of Nagpuri Buffaloes indicate that the udder of buffalo is the indicator of potentiality of milk production and is of economic importance in reference to selection of dairy animals in market. The udder of buffaloes of Purnathadi strain of Nagpuri buffaloes are well developed compact with short or long and big or small teats. It is observed that the average length of udder in age group of 4–5, 5–7, 7–9, 9-11 years of age group was found to be 39.374 ± 0.554 , 42.091 ± 0.642 , 48.367 ± 0.330 and 55.306 ± 0.035 cm respectively. Similarly, the average length of udder of Ellichpuri in age group of 4–5, 5–7, 7–9, 9-11 years of age group was found to be 40.570 ± 0.515 , 44.405 ± 0.719 , 49.659 ± 0.504 and 55.830 ± 0.079 cm respectively. The length of udder progressively increased with the age up to 57.340 ± 0.930 cm. Pooled average of udder length was 49.560 ± 0.549 cm. The length of udder progressively increased with the age up to 56.831 ± 6.695 cm. Pooled average of udder length was 48.393 ± 0.451 cm.

Patel *et al.* (2016) conducted study on udder and teat measurements and their relation with milk production in crossbred cows concluded that the average length of udder was 58.24 ± 0.68 cm.

Badekar (2016) studied on the udder and teat morphology and their relationship with milk yield in murrah buffaloes (n=500) and it was carried out at the different farms of the Aarey campus of Goregoan (East) of Mumbai

district of Maharashtra, Department Of Livestock Production And Management Bombay Veterinary College, Mumbai. Udder length in Murrah buffalo ranged from 51.40 ± 0.38 to 52.84 ± 0.17 cm. with an average of 54.81 ± 0.57 cm was recorded. The mean \pm SE of udder length for bowl shaped udder was 52.22 ± 0.08 cm, for globular shaped udder were 51.40 ± 0.38 cm, for goaty shaped udder 52.33 ± 0.15 cm, whereas for pendulous udder were 52.84 ± 0.17 cm. Maximum udder length found in pendulous udder and maximum udder width found in goaty shaped udder.

Sangame (2016) studied on udder and teat morphology in marathwadi buffalo (n=500) in Latur district of Marathwada region of Maharashtra. He observed that the Marathwadi buffalo found with Medium sized udder. Udder length in Marathwadi buffalo ranged from 47.46 ± 0.82 to 62.17 ± 0.33 cm. with an average of 54.81 ± 0.57 cm. further he was also stated that, there was positive linear correlation between udder length and parity up to fourth order, later on it decreased with the advancement of parity order.

Kaur (2017) conducted study at the Livestock Farms of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. A total of 81 lactating buffaloes comprising 49 Murrah and 32 Nili Ravi were included in the study. The mean \pm SE value of Udder length was observed to be 70.74 ± 0.8 cm. The udder length and the udder width did not differ between breeds.

Modh *et al.* (2017) conducted study on effect of parity on udder and teat biometry and its association with milk yield in gir cows found that the average length, udder was 61.95 ± 1.20 cm.

Patel and Trivedi (2018) studied morphometric characteristics of udder and teats in the crossbred cows (n=200) from 13 different dairy farms located in Anand district of Gujarat state were utilized for this study. In crossbred cows the mean udder length, width and depth ranged from 50.87 ± 2.57 cm in goaty udders to 64.86 ± 1.89 cm in pendulous udders, 57.94 ± 2.31 cm in goaty

udders to 73.02 ± 2.05 cm in pendulous udders and 20.43 ± 0.92 cm in goaty udders to 27.18 ± 1.01 cm in pendulous udders, respectively.

Hiremath *et al.* (2020) Studied the strain-wise udder and teat biometry, lactation milk yield and correlations in (n-256) Deoni cattle. The overall mean of udder length was found to be 41.476 ± 0.3570 .

Sathiyabarathi M. and Vasantha Kumar S. (2020) conducted a study in dairy herds of Tirunelveli, Thoothukudi and Tenkasi districts of Tamil Nadu. The udder and teat measurements were recorded for 75 lactating Jersey crossbred cows with different parities. They recorded that the mean \pm SE value of udder length in different parities ranged from 49.61 ± 1.16 to 55.48 ± 1.22 cm.

Ranjitha *et al.* (2021) studied the relationship of Udder Conformation with milk yield, fat and solids-not-fat percent in murrh graded. the mean \pm S.E of udder length of different udder shapes ranged from 47.44 ± 0.37 to 51.55 ± 0.90 cm. the overall average udder length was 48.1 ± 0.33 cm.

Udder width

Radekar *et al.* (2003) studied on udder measurement traits of Pandharpuri buffaloes. The overall least square mean for udder width was 38.98 ± 0.20 cm.

Tayade *et al.* (2010) recorded phenotypic characteristics of Gaolao strain of Nagpuri buffaloes in Wardha district of Maharashtra, The average width of udder was 25.76 ± 0.37 cm. further he reported that, with the advancement in age, it increased progressively up to 11 years of age, and it was 49.84 ± 0.41 cm. whereas the pooled average width of udder was 44.49 ± 3.66 cm.

Prasad *et al.* (2010) Studied on the udder measurements as affected by parity in Murrah buffaloes. The mean and S.E values of udder width in the present study in Murrah buffaloes with different parity ranged from

48.61±0.60 cm in 1st parity, 49.49±0.49 cm in 2nd parity, 53.87±0.70cm in 3rd parity and 50.71±1.02 cm in 4th parity. The overall mean for udder width was 50.63±0.36 cm. there was an increase in udder width from 1st to 3rd lactation.

Lavana *et al.* (2011) Studied on udder measurement traits of 51 Surti buffaloes. The overall least square means for like udder width were 49.4±1.4 cm.

Gubbawar *et al.* (2012) revealed that, Irrespective of age, the overall average udder width in Gaolao buffalo was 39.75 cm with a range from 29.75 to 58.00 cm. This means the udder was small in size on the basis of width.

Yosbanis *et al.* (2013) studied 492 buffaloes of two cattle farm of the occident of Cuba were used; they were among one and 17 lactations, Udder width was measured using rulers, compass and calipers and recorded in the unit centimeter (cm.) after statistical analysis of the obtained data, It was observed that, the average value 21.54, cms were recorded for udder width. The width showed moderate to high correlations (0.24 to 0.54) with all the production 7 variables. It is concluded that the correlations among the variables morphological and productive evaluated were moderate to high.

Thalkar *et al.* (2016) studied Morphological Characteristics of Purnathadi and Ellichpuri Strain of Nagpuri Buffaloes indicate that width of udder in Purnathadi varies in the different age groups. It is evident that the width of the udder in the age group 4–5, 5–7, 7–9, 9–11 years was found 27.910 ± 0.470, 31.055 ± 0.437, 35.494 ± 0.375, 39.004 ± 0.055 cm. The width of udder progressively increased up to 11 years of age. At 11 years of age width of udder was 46.531 ± 0.635 cm. Pooled average of width was found 35.998 ± 0.395 cm. Similarly the width of the udder in Ellichpuri in the age group 4–5, 5–7, 7–9, 9–11 years was found 27.410 ± 0.471 , 30.690 ± 0.531, 34.128 ± 0.553 , 43.100 ± 0.072 cm. The width of udder progressively increased up to 11 years of age. At 11 years of age width of

udder was 48.002 ± 0.720 cm. Pooled average of width was found 36.665 ± 0.469 cm.

Patel *et al.* (2016) conducted study on udder and teat measurements and their relation with milk production in crossbred cows concluded that the average width of udder was 65.45 ± 0.70 cm.

Badekar (2016) studied on the udder and teat morphology and their relationship with milk yield in murrah buffaloes (n=500) and it was carried out at the different farms of the Aarey campus of Goregoan (East) of Mumbai district of Maharashtra, Department Of Livestock Production And Management Bombay Veterinary College, Mumbai. Udder width in Murrah buffalo ranged from 49.24 ± 0.10 to 51.66 ± 0.50 cm. with an average of 49.57 ± 0.10 cm was recorded. The mean \pm SE of udder width for bowl shaped udder was 49.24 ± 0.10 cm, for globular shaped udder was 50.67 ± 0.34 cm, for goaty shaped udder 51.66 ± 0.50 cm, whereas for pendulous udder was 50.77 ± 0.31 cm. Maximum udder width found in goaty shaped udder.

Sangame (2016) studied on udder and teat morphology in Marathwadi buffalo (n=500) in Latur district of Marathwada region of Maharashtra. He observed that the Marathwadi buffalo found with Medium sized udder. Udder width in Marathwadi buffalo ranged from 30.24 ± 0.41 to 38.36 ± 0.39 cm. with an average of 34.35 ± 0.40 cm was recorded. It was observed that, average udder width at First, Second, Third, Fourth and Above fourth parity of Marathwadi buffalo were 30.24 ± 0.41 , 33.01 ± 0.51 , 37.87 ± 0.38 , 38.36 ± 0.39 and 33.26 ± 0.38 cm respectively. From first parity there was positive correlation among the width of udder and the order of parity up to fourth parity, but after that, udder width showed negative correlation with advanced parity.

Kaur (2017) conducted study at the Livestock Farms of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. A total of 81 lactating buffaloes comprising 49 Murrah and 32 Nili Ravi were included in

the study. The mean \pm SE value of Udder width was observed to be 50.21 \pm 0.87 cm. The udder length and the udder width did not differ between breeds.

Modh *et al.* (2017) conducted study on effect of parity on udder and teat biometry and its association with milk yield in gir cows found that the average width of udder was 62.99 \pm 1.17cm.

Patel and Trivedi (2018) studied morphometric characteristics of udder and teats in the crossbred cows (n=200) from 13 different dairy farms located in Anand district of Gujarat state were utilized for this study. In crossbred cows the mean udder length, width and depth ranged from 50.87 \pm 2.57 cm in goaty udders to 64.86 \pm 1.89 cm in pendulous udders, 57.94 \pm 2.31 cm in goaty udders to 73.02 \pm 2.05 cm in pendulous udders and 20.43 \pm 0.92 cm in goaty udders to 27.18 \pm 1.01 cm in pendulous udders, respectively.

Hiremath *et al.* (2020) studied the strain-wise udder and teat biometry, lactation milk yield and correlations in (n-256) Deoni cattle. The overall mean of udder width was found to be 37.773 \pm 0.4770.

Sathiyabarathi M. and Vasantha Kumar S. (2020) Conducted study in dairy herds of Tirunelveli, Thoothukudi and Tenkasi districts of Tamil Nadu. The udder and teat measurements were recorded for 75 lactating Jersey crossbred cows with different parities. And recorded that the mean \pm SE values of udder width (cm) in different parities ranged from 55.48 \pm 1.22, 46.23 \pm 1.38.

Ranjitha *et al.* (2021) studied the relationship of Udder Conformation with milk yield, fat and solids-not-fat percent in murrh graded. The mean \pm S.E of udder width of different udder shapes ranged from 41.81 \pm 1.18 to 46.15 \pm 0.94 cm. The overall average udder width was 42.80 \pm 0.32 cm.

Udder depth

Bhuiyan *et al.* (2004) studied the mammary system conformation in dairy cow on milk yield found the mean udder depth in dairy cow was 12.57 ± 0.32 .

Prasad *et al.* (2010) Studied on the udder measurements as affected by parity in Murrah buffaloes. The mean and S.E values of udder depth in the present study in Murrah buffaloes with different parity ranged from 15.46 ± 0.17 cm in 1st parity, 15.60 ± 0.19 cm in 2nd parity, 15.78 ± 0.18 cm in 3rd parity and 15.51 ± 0.26 cm in 4th parity. The overall mean for udder depth was 15.59 ± 0.26 cm. there was an increase in udder depth from 1st to 3rd lactation.

Lavania *et al.* (2011) Studied on udder measurement traits of 51 Surti buffaloes. The overall least square means for like udder depth were 9.4 ± 0.5 cm.

Yosbanis *et al.* (2013) studied 492 buffaloes of two cattle farm of the occident of Cuba were used; they were among one and 17 lactations. He observed that the average value recorded for the udder depth was 25.30 cm.

Bharti *et al.* (2015) conducted to evaluate the effect of lactation order on morphological traits of teat and udder in Murrah buffaloes. A total of 59 buffaloes were selected for the study which were milked twice daily (morning and evening) by hand milking method. From date of calving to 7th month of lactation, the udder morphological traits viz. teat length, teat diameter, distance between teats, udder dimension, udder depth and height of udder from the ground were recorded fortnightly by using measuring tape and vernier calliper the height of udder base from the ground was significantly higher in first lactation order than subsequent parity except for 2nd lactation order. It was concluded that udder morphological traits of Murrah buffaloes varied from lactation-to-lactation order as the age

advanced which could be deciding factors for selection of precious dairy animals to maximize the profitability at farm.

Patel *et al.* (2016) conducted study on udder and teat measurements and their relation with milk production in crossbred cows concluded that the average depth of udder was 23.06 ± 0.34 cm.

Sangame (2016) studied on udder and teat morphology in marathwadi buffalo (n=500) in Latur district of Marathwada region of Maharashtra. He observed that, average udder depth at First, Second, Third, Fourth and Above fourth parity were 8.39 ± 0.09 , 10.19 ± 0.12 , 11.38 ± 0.14 , 12.29 ± 0.08 and 11.03 ± 0.08 cm respectively.

Kaur (2017) conducted study at the Livestock Farms of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. A total of 81 lactating buffaloes comprising 49 Murrah and 32 Nili Ravi were included in the study. The mean \pm SE value of Udder depth was observed to be 12.6 ± 0.38 cm. the udder depth was found significantly ($p < 0.05$) higher in Nili Ravi buffaloes (13.49 ± 0.58) than that in Murrah (11.97 ± 0.48).

Modh *et al.* (2017) conducted study on effect of parity on udder and teat biometry and its association with milk yield in gir cows found that the average depth of udder was 25.62 ± 0.43 cm.

Patel and Trivedi (2018) studied morphometric characteristics of udder and teats in the crossbred cows (n=200) from 13 different dairy farms located in Anand district of Gujarat state were utilized for this study. In crossbred cows the mean udder length, width and depth ranged from 50.87 ± 2.57 cm in goaty udders to 64.86 ± 1.89 cm in pendulous udders, 57.94 ± 2.31 cm in goaty udders to 73.02 ± 2.05 cm in pendulous udders and 20.43 ± 0.92 cm in goaty udders to 27.18 ± 1.01 cm in pendulous udders, respectively.

Hiremath *et al.* (2020) studied the strain-wise udder and teat biometry, lactation milk yield and correlations in (n-256) Deoni cattle. The overall mean of udder depth 15.238 ± 0.1070 cm.

Sathiyabarathi, M. and Vasantha Kumar S. (2020) Conducted study in dairy herds of Tirunelveli, Thoothukudi and Tenkasi districts of Tamil Nadu. The udder and teat measurements were recorded for 75 lactating Jersey crossbred cows with different parities. They recorded that the mean \pm SE values of udder depth (cm) in different parities ranged from 15.12 ± 0.92 to 19.76 ± 0.38 .

Ranjitha *et al.* (2021) studied the relationship of Udder Conformation with milk yield, fat and solids-not-fat percent in murrrah graded. The mean \pm S.E of udder depth of different udder shapes ranged 11.67 ± 0.05 to 12.3 ± 0.16 cm. The overall average udder depth was 11.80 ± 0.05 cm.

Udder shape

Rao & Murthy (1991) studied the incidence of different udder types in buffalo and their frequency distribution among the three genetic groups and revealed that, of the four types of udders identified, 58.1, 32.8, 6.1, 3.0 % were of Bowl, Globular, Goat and pendulous respectively. The same pattern of distribution of udder types was observed in all genetic groups, while the former two types were preponderant. The incidence of Bowl udder was significantly higher than that of Globular udders, the variation in the distribution of Pendulous type among three genetic groups was statistically non-significant, He also reported that, the distribution pattern of udder type among buffaloes in different lactations revealed a trend in which the frequency of bowl udder declines with advanced lactation.

Chaki *et al.* (1999) studied percentage occurrence of different types of udder and teat in primiparous crossbred cows and reported that, bowl type udder had the highest frequency followed by rounded and goat type.

Cylindrical teats were found to be in the highest frequency followed by funnel and bottle shaped in both fore and rear quarters.

Pundir *et al.* (2000) investigated the breed distribution, management practices under field conditions, breed performance and development of breed descriptor for Mehsana buffalo. Seven microsatellite markers were analysed in Mehsana buffalo. He reported that, the udder is well developed and well set and in good milking animals it is carried well behind.

Sonwane *et al.* (2002) study the udder characterization (shape of udder, size of fore and rear udders) of milk cows (n=200) and buffaloes (n=200) were studied by interviewing 400 dairy farmers randomly selected from 10 villages in Maharashtra, India. Bowl, round and pendulous shaped udders were common in Marathwadi, Nagpuri, and Jaffrabadi and Murrah buffaloes, respectively. Bowl shaped udders were mainly observed in local cows and Red Kandhari while pendulous shaped udders were common in crossbred cows. Medium sized fore udders and large sized rear udders were common in all cows and buffaloes except the Murrah buffalo. Small sized fore udder were mainly found in local 10 cows while Red Kandhari and crossbred had medium sized fore udder. Medium sized rear udder was generally observed in all cow breeds.

Radekar *et al.* (2003) studied on udder measurement traits of Pandharpuri buffaloes. Trough shaped udders (38%) were found in most of all Pandharpuri buffaloes followed by Bowl shaped (29%), Round shaped (24%) and Pendulous shaped (9%) udders.

Bainwad *et al.* (2007) studied on udder characteristics of Marathwadi, Pandharpuri and Surti buffaloes in Marathwada region, in III lactation age group, about 40.00 per cent buffaloes had round shape udder followed by I and II (38.00 per cent) bowl shape, above VI (18.50 per cent) pendulous and IV to VI (3.50 per cent) trough shape udder. However, when referred the result breed wise, Marathwadi breed had predominantly bowl

shape (44.04 per cent) while Pandharpuri (43.24 per cent) and Surti pendulous (41.18 per cent) shape of udder respectively. Occurrence of medium size fore udder (66.00%) and large size rear udder (56.50%) was recorded maximum in all the buffalo breeds. Medium size fore udder was recorded highest in Marathwadi (67.89%) followed by Pandharpuri (64.86%) and Surti (58.82%). In Marathwadi, Pandharpuri and Surti large size rear udder had a frequency of 59.63, 52.70 and 52.94%, respectively.

Bharadwaj *et al.* (2007) conducted a study to establish relationship between some breed characteristics of Murrah buffaloes such as udder and teat conformation with milk production. Observed on 245 lactating buffaloes from institute and 150 from field were recorded. These buffaloes were grouped into different categories based on level of variation in the morphological characters of each animal. The data were statistically analyzed and relationship of each character with milk yield was examined. The results indicated that shape of udder and teats were associated with milk production. Significantly higher milk yield was obtained in buffaloes having long and deep udders with higher rear attachment than those having short and shallow udders with low rear attachment.

Gubbawar *et al.* (2012) studied 1000 Gaolao strain of Nagpuri buffalo breed was belonging to different age groups as I (4-5 years), II(6-7 years), III (8- 9 years) and IV (above 10years). The udder shape was observed in 1000 Gaolao buffaloes which comprised the different age groups from 4 years onwards. It was noted that majority of Gaolao buffaloes (53.40%) possessed bowl shaped udder and substantial number of buffaloes (38.60%) indicated round shaped udder. Moreover sizeable number of buffaloes (18.00%) exhibited goat type shaped udder. This means there would not be specific shape of udder in Gaolao type buffaloes. However, statistical significance showed that bowl shaped udder as a typical character for gaolao type buffaloes.

Sonwane (2015) studied the percentile frequency distribution of different udder shapes of Marathwadi buffalo in its hometract. Total 1400 buffaloes were screened for the recording of the data. After the statistical analysis by using simple mathematical calculations he observed that, In hometract of Marathwadi Buffalo percentile frequency distribution were 35.95, 35.48, 25.24, 3.33 % adult female were found with Round, Trough, bowl shaped and pendulous udder respectively. In Latur district 18.33, 41.67, 36.67 and 3.33% adult female found with Bowl, Round, Trough and Pendulous shape udder respectively.

Bharti *et al.* (2015) conducted to evaluate the effect of lactation order on morphological traits of teat and udder in Murrah buffaloes. A total of 59 buffaloes were selected for the study which were milked twice daily (morning and evening) by hand milking method. From date of calving to 7th month of lactation, the udder morphological traits viz. teat length, teat diameter, distance between teats, udder dimension, udder depth and height of udder from the ground were recorded fortnightly by using measuring tape and vernier calliper the udder depth rear in 9th lactation order (20.05 ± 0.27) was significantly ($p < 0.05$) higher than 8th lactation order (17.11 ± 0.32).

Thalkar *et al.* (2016) studied Morphological Characteristics of Purnathadi and Ellichpuri Strain of Nagpuri Buffaloes revealed that the udder characteristics were observed in 500 she buffaloes which included age group from 4 -5 to above 11 years. The percentage value was highest for bowl shaped udder (53.80%) followed by round shaped udder (32.60%) and goat type udder (13.60%) was found in Purnathadi strain of Nagpuri buffaloes. The percentage value was highest value of bowl shape udder (57.40%) followed by round shaped udder (24.00%) and goat type udder (18.60%) was found in Ellichpuri strain of Nagpuri buffaloes.

Badekar (2016) studied on the udder and teat morphology and their relationship with milk yield in murrah buffaloes (n=500) and it was carried

out at the different farms of the Aarey campus of Goregoan (East) of Mumbai district of Maharashtra. It was observed that Out of 500 buffaloes near about 330 Murrah buffaloes observed with bowl shaped udder likewise 75 buffaloes with globular shape, 50 with goaty shaped and 45 with pendulous udder shaped. Percentage of occurrence of udder shape like bowl, globular, goaty and pendulous were 66 %, 15%, 10% and 9% respectively.

Sangame (2016) studied on udder and teat morphology in marathwadi buffalo (n=500) in Latur district of Marathwada region of Maharashtra. And observed that the shape of udder in Marathwadi buffalo in its different parities showed percentile average as 19.4 % Trough, 44.8% Bowl shaped, 32.6% Round and 3.2% pendulous shaped udder. It was revealed that, bowl shape of udder was prominently observed in Marathwadi buffalo followed by Round shape and trough type and very scanty population of Marathwadi buffalo bears pendulous shaped udder.

Kaur (2017) studied on conformational and morphometric evaluation of buffalo udder and teats in relation to udder health. The study was conducted at the Livestock Farms of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. A total of 81 lactating buffaloes comprising 49 Murrah and 32 Nili Ravi were included in the study. The bowl udder shape was recorded in 55.56% of animals followed by round 38.27%, goaty 3.70% and stepped udders 2.47%. The breed wise no significant difference ($\chi^2 = 6.22$, $p = 0.10$, $df = 3$; Fishers Exact=0.002, $p=0.07$) was found in the occurrence of udder shapes in Murrah and Nili Ravi buffaloes But, otherwise the Murrah animals were seen to have more bowl (64.58% vs. 42.42% in Nili Ravi) and the Nili Ravi more round (45.45% vs. 33.33% in Murrah) or stepped (6.06% vs. Nil in Murrah) udders.

Patel and Trivedi (2018) studied the crossbred cows (n=200) from 13 different dairy farms located in Anand district of Gujarat state were utilized for this study. In crossbred cows, the frequencies of trough (bowl), round,

goaty and pendulous shaped udder were 56.5 %, 19.5 %, 7.5 % and 16.5 %, respectively.

Teat morphology in buffaloes

Teat length

Marai *et al.* (2001) reported that, effects of lactation month on most udder traits were significant ($P < 0.01$ or 0.05). Teat size (length and diameter) tended to decrease after the fourth month of lactation. Such difference was significant between the first four months and the later months of lactation. The decrease in the later months of lactation period may be due to the lower milk yield during the later months of the lactation period.

Radekar *et al.* (2003) studied on teat measurement traits of Pandharpuri buffaloes, The overall least square mean for fore teat length and hind teat length were 7.13 ± 0.16 , and 7.52 ± 0.16 cm respectively.

Patro *et al.* (2003) studied on physical characteristics of Chilika buffalo. The average value for Teat length in five localities was 5.1 ± 0.4 cm.

Prasad *et al.* (2010) Studied on the udder and teat measurements as affected by parity in Murrah buffaloes. The mean and S.E values of Teat length in the present study in Murrah buffaloes with different parity ranged from 6.90 ± 0.20 cm in 1st parity, 7.59 ± 0.33 cm in 2nd parity, 8.71 ± 0.31 cm in 3rd parity and 8.37 ± 0.36 cm in 4th parity. The overall mean for Teat length was 7.81 ± 0.15 cm. there was an increase in Teat length from 1st to 3rd lactation.

Lavania *et al.* (2011) Studied on teat measurement traits of 51 Surti buffaloes. The overall least square means for like teat length front and teat length rear were 6.9 ± 0.3 and 7.7 ± 0.4 cm, respectively.

Gubbawar *et al.* (2012) observed an average the teat length irrespective of age group was varying from 10.00 to 20.00 cm with average value of 16.87cm. The trend therefore indicates that gaolao buffaloes possessed long teats.

Badekar (2016) studied on the udder and teat morphology and their relationship with milk yield in murrah buffaloes (n=500) and it was carried out at the different farms of the Aarey campus of Goregoan (East) of Mumbai district of Maharashtra. It was observed that the overall mean \pm S.E value of teat lengths of left fore, right fore, and left hind and right hind teats were 6.90 ± 0.06 cm, 7.01 ± 0.05 cm, 7.68 ± 0.07 cm and 8.15 ± 0.06 cm respectively.

Kaur (2017) conducted study at the Livestock Farms of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. A total of 81 lactating buffaloes comprising 49 Murrah and 32 Nili Ravi were included in the study. The mean \pm SE value of teat length 8.75 ± 0.12 was recorded.

Sangame (2016) studied on udder and teat morphology in marathwadi buffalo (n=500) in Latur district of Marathwada region of Maharashtra and recorded the average Teat length at First, Second, Third, Fourth and above fourth parity were 4.63 ± 0.08 , 5.30 ± 0.06 , 6.21 ± 0.08 , 7.07 ± 0.08 and 6.10 ± 0.11 cm respectively.

Patel and Trivedi (2018) studied the crossbred cows (n=200) from 13 different dairy farms located in Anand district of Gujarat state were utilized for this study. In crossbred cows, the mean teat length ranged from 5.21 ± 0.27 cm in pear shaped teat to 5.96 ± 0.12 cm in bottle shaped teat.

Hiremath *et al.* (2020) studied the strain-wise udder and teat biometry, lactation milk yield and correlations in (n=256) Deoni cattle. The overall mean of fore teat length and rear teat length were found to be 3.968 ± 0.0790 cm and 3.505 ± 0.0750 cm respectively.

Ranjitha *et al.* (2021) studied the relationship of Udder Conformation with milk yield, fat and solids-not-fat percent in murrah graded. The overall mean (\pm S.E) of teat lengths of right fore, left fore, right rear, left fore were 5.42 ± 0.02 , 5.60 ± 0.02 , 5.74 ± 0.03 and 5.96 ± 0.02 cm, respectively. Similarly the overall mean (\pm S.E) of diameter of the teat in right fore, left fore, right rear, left rear were 2.48 ± 0.01 , 2.60 ± 0.01 , 2.72 ± 0.01 and 2.87 ± 0.02 cm, respectively.

Teat diameter

Batra (1984) studied relationships among udder measurements in young dairy heifers and revealed Significant positive phenotypic and genetic correlations were observed between teat length and teat diameter indicating that longer teats were wider at the mid-point. The high positive genetic correlations among teat measurements suggest only a single teat measurement need be included in selection. Teat distance was significantly ($P < 0.01$) phenotypically positively correlated with the teat diameter and genetically with both teat length and teat diameter in the H line heifers. Phenotypic correlations of teat length, teat diameter and teat distance with udder height were all negative suggesting that longer and wider teats tended to be on udders that were closer to the ground. Genetic correlations of teat length and teat diameter with udder height were mostly small and non-significant except teat diameter for the A line heifers which was significantly negatively correlated with udder height.

Akhtar *et al.* (1999) studied observations of 433 swamp buffaloes in different lactation and stage of lactation and reported that, the mean teat diameter of left fore, right fore, left hind and right hind in different lactation order varied from 1.36 to 2.22 cm. Overall mean value 1.75 ± 0.02 cm; from 1.37 ± 2.23 cm, Overall mean value 1.76 ± 0.02 cm; from 1.47 ± 2.23 cm, Overall mean value 1.87 ± 0.02 cm; from 1.48 ± 2.35 cm, Overall mean value 1.87 ± 0.02 cm, from 1.48 ± 2.34 cm respectively. Progressive increase in teat diameter was noted up 16 to 5th order of lactation. He also reported that, the teat length and

diameter was more in early stage and then gradually declined in kid and late stage of lactation.

Prasad *et al.* (2010) Studied on the teat measurements as affected by parity in Murrah buffaloes. The mean and S.E values of teat diameter in the present study in Murrah buffaloes with different parity ranged from 2.61 ± 0.05 cm in 1st parity, 2.75 ± 0.04 cm in 2nd parity, 2.90 ± 0.04 cm in 3rd parity and 2.82 ± 0.06 cm in 4th parity. The overall mean for teat diameter was 2.76 ± 0.02 cm. there was an increase in teat diameter from 1st to 3rd lactation.

Lavania *et al.* (2011) Studied on teat measurement traits of 51 Surti buffaloes. The overall least square means for like teat circumferences front and teat circumferences rear were 8.1 ± 0.4 and 9.4 ± 0.3 cm respectively.

Bharti *et al.* (2015) conducted to evaluate the effect of lactation order on morphological traits of teat and udder in Murrah buffaloes. A total of 59 buffaloes were selected for the study which were milked twice daily (morning and evening) by hand milking method. From date of calving to 7th month of lactation, the udder morphological traits viz. teat length, teat diameter, distance between teats, udder dimension, udder depth and height of udder from the ground were recorded fortnightly by using measuring tape and vernier calliper. The teat diameter (cm) of left fore quarter in 1st lactation order was significantly ($p < 0.05$) lower than all other lactation orders.

Badekar (2016) studied on the udder and teat morphology and their relationship with milk yield in murrah buffaloes ($n=500$) and it was carried out at the different farms of the Aarey campus of Goregoan (East) of Mumbai district of Maharashtra. It was observed that the mean value \pm S.E of teat diameters were 2.61 ± 0.01 cm, 2.66 ± 0.00 cm, 2.77 ± 0.01 cm and 2.84 ± 0.00 cm respectively.

Sangame (2016) studied on udder and teat morphology in marathwadi buffalo ($n=500$) in Latur district of Marathwada region of Maharashtra and

recorded the average Teat diameter First, Second, Third, Fourth and above fourth parity were 3.00 ± 0.08 , 3.85 ± 0.08 , 4.86 ± 0.12 , 6.41 ± 0.17 and 5.61 ± 0.14 cm respectively.

Kaur (2017) conducted study at the Livestock Farms of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. A total of 81 lactating buffaloes comprising 49 Murrah and 32 Nili Ravi were included in the study. The mean \pm SE value of teat diameter 3.41 ± 0.04 was recorded.

Patel and Trivedi (2018) studied the crossbred cows ($n=200$) from 13 different dairy farms located in Anand district of Gujarat state were utilized for this study. In crossbred cows, the mean teat diameter ranged from 2.04 ± 0.08 cm in pear shaped teat to 2.86 ± 0.06 cm in bottle shaped teat.

Hiremath *et al.* (2020) studied the strain-wise udder and teat biometry, lactation milk yield and correlations in ($n=256$) Deoni cattle. The overall mean of fore teat diameter and rear teat diameter were found to be 2.029 ± 0.0130 and 1.930 ± 0.0120 cm respectively.

Ranjitha *et al.* (2021) studied the relationship of Udder Conformation with milk yield, fat and solids-not-fat percent in murrah graded. the overall mean (\pm S.E) of diameter of the teat in right fore, left fore, right rear, left rear were 2.48 ± 0.01 , 2.60 ± 0.01 , 2.72 ± 0.01 and 2.87 ± 0.02 cm, respectively.

Teat shape

Hickman (1964) studied the teat shapes in dairy cow into three classes, funnel, cylindrical and bottle shaped. Cylindrical shaped teats were observed to be most prevalent in dairy cows.

Rao & Murthy (1991) studied the udder morphology in Murrah buffalo and reported that, the incidence of different types of teats in order of frequency was Cylindrical, Pear, Funnel and Bottle types. The last being rear between

genetic groups within teat types Murrah buffalo a significantly a higher proportion of Cylindrical teats.

Chaki *et al.*(1999) studied percentage occurrence of different types of udder and teat in primiparous crossbred cows and reported that, bowl type udder had the highest frequency followed by rounded and goat type. Cylindrical teats were found to be in the highest frequency followed by funnel and bottle shaped in both fore and rear quarters.

Sonwane *et al.* (2002) study the teat characterization (shape and tip of teats) of milk cows (n=200) and buffaloes (n=200) were studied by interviewing 400 dairy farmers randomly selected from 10 villages in Maharashtra, India. Cylindrical teat shapes were common in Marathwadi, Nagpuri, and Jaffrabadi and Murrah buffaloes breeds.

Bhuiyan *et al.* (2004) conducted the study on the udder shapes and measurements of dairy cows and it was found that number of round shaped udder was maximum compared to the bowl and goat type of udders.

Bainwad *et al.* (2007) studied on Teat characteristics of Marathwadi, Pandharpuri and Surti buffaloes in Marathwada region, the result showed that cylindrical teat (53.50%) was most common as compared to funnel (27.50%) and pear (19.00%) shape teats in buffaloes. The buffaloes had wide placement of teats at back (52.50%) in most cases.

Abdullah *et al.* (2013) studied the relationship of Udder and Teat Morphology Relationship of Udder and Teat Morphology with Milk Production in Nili-Ravi buffalo (n=200) observed 89% Nili-Ravi buffalo were observed for cylindrical shape teat followed by 7% funnel and 4% bottle shape teats.

Badekar (2016) studied on the udder and teat morphology and their relationship with milk yield in murrah buffaloes (n=500) and it was carried out

at the different farms of the Aarey campus of Goregoan (East) of Mumbai district of Maharashtra. It was observed that Out of 500 animals about 285 Murrah buffaloes observed with cylindrical shaped teats followed by conical shaped, then pear shaped, bottle shaped and funnel shaped teats. Percentage wise observations were 57%, 16%, 12%, 9% and 6% respectively.

Sangame (2016) studied on udder and teat morphology in Marathwadi buffalo (n=500) in Latur district of Marathwada region of Maharashtra. And observed that the shape of teat in Marathwadi buffalo in its different parities showed percentile average as 49.20 % Cylindrical, 24.60 % Funnel shaped, 19.40% Bottle and 6.8 % Conical shaped teats. From the results it may be revealed that, cylindrical shape of teat was prominently observed in Marathwadi buffalo followed by Funnel Shaped, Bottle shaped and Conical shaped.

Kaur (2017) conducted study at the Livestock Farms of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. A total of 81 lactating buffaloes comprising 49 Murrah and 32 Nili Ravi were included in the study. And revealed that the out of total 317 functional teats, 21.45% were bottle shaped, 32.81% were pointed or conical, 40.06% were cylindrical and 5.68% were others. Among breeds, the Murrah buffaloes were found to possess more cylindrical teats and less short/ other teats as compare to that in Niliravi buffaloes; the difference was near to significant ($\chi^2 = 7.40$, $p = 0.058$, $df=3$; Fishers Exact= 0.00006, $p=0.06$).

Patel and Trivedi (2018) studied the crossbred cows (n=200) from 13 different dairy farms located in Anand district of Gujarat state were utilized for this study. In crossbred cows the frequencies of cylindrical, funnel, bottle and pear shaped teats were 24.75 %, 48.63 %, 22.13 % and 4.5 %, respectively.

Milk Yield

Test day milk yield

Bhuiyan *et al.* (2004) conducted the study on the udder shapes and measurements of dairy cows and it was found that the udder of dairy cows with bowl shaped yielded the maximum test day milk yield (3.4 ± 0.33 kg), medium in goaty shaped udder (3.1 ± 0.20 kg) and less in round shaped udder (2.8 ± 0.19 kg).

Mishra *et al.* (2007) studied the buffalo genetic resource of India Pandharpuri found that the average daily milk yield of Pandharpuri buffalo is 4.90 lt.

Kushwaha *et al.* (2013) studied Production and Reproductive Performance of Bhadawari Buffaloes in Uttar Pradesh, India revealed that that the average daily milk yield bhadawari buffaloes was observed to be 4.30 ± 0.06 kg.

Badekar (2016) studied on the udder and teat morphology and their relationship with milk yield in murrah buffaloes (n=500) and it was carried out at the different farms of the Aarey campus of Goregoan (East) of Mumbai district of Maharashtra, Department Of Livestock Production And Management Bombay Veterinary College, Mumbai. Average daily milk yield in Murrah buffalo ranged from 6.50 ± 0.20 to 7.03 ± 0.06 kg. was recorded. The mean \pm SE of average daily milk yield for bowl shaped udder was 7.03 ± 0.06 kg, for globular shaped udder were 6.64 ± 0.12 , for goaty shaped udder 6.78 ± 0.16 , whereas for pendulous udder were 6.50 ± 0.20 kg.

Panicker *et al.* (2016) studied the production performance of Nagppuri buffalo under field condition found that the overall average DMY was 3.88 ± 0.05 kg with a coefficient of variation of 39.71%. Differences between

lactations were highly significant ($P \leq 0.01$). The means of DMY from first to seventh lactation differ significantly.

Hamand *et al.* (2019) studied Phenotypic Characteristics of Shahi Strain of Nagpuri Buffaloes in Chandrapur District of Maharashtra, India and concluded that the average daily milk yield of Shahi strain of Nagpuri buffaloes was observed to be 4.06 ± 0.08 kg.

Lactational milk yield

Mishra *et al.* (2007) studied the buffalo genetic resource of India Pandharpuri found that the average lactational milk yield of Pandharpuri buffalo is 1207.70 lt.

Kushwaha *et al.* (2013) studied Production and Reproductive Performance of Bhadawari Buffaloes in Uttar Pradesh, India revealed that that the average lactationa milk yield bhadawari buffaloes was observed to be 1250 ± 24.6 kg.

Panicker *et al.* (2016) studied the production performance of nagppuri buffalo under field condition found that the overall average 305 days milk yield was observed to be 1230.46 ± 17.93 kg with a CV of 41.17%. Highly significant difference ($P \leq 0.01$) in lactation yield was observed between parities. The average lactation yield increased up to fourth calving after which it declined.

Hamand *et al.* (2019) studied Phenotypic Characteristics of Shahi Strain of Nagpuri Buffaloes in Chandrapur District of Maharashtra and concluded that The milk yield per lactation was $1,220.84 \pm 41.57$ kg.

Milk yield and Relationship

Ozbeyaz *et al.* (1998) analyzed udder and teat measurement in brown swiss cows according to lactation number and milk yield at 3 stages of

lactation (60, 150, 240 days) and concluded that teat dimensions did not significantly affect milk yield, however udder length significantly affected yield. The means of 305 day milk yield reported for bottle, cylindrical and funnel teat shape groups were 5786.60, 5556.55, and 5276.77 kg respectively.

Ghosh and Prasad (1999) studied the influence of udder measurements and udder shape on test day milk yield on comparison between 3 lactational stages, 3 parities, and 4 udder types found that udder length and width had positive correlation with TDMY. Significantly higher TDMY was recorded in pendulous and bowl type udders than in a goaty udder. Further differences observed in measurements were not significant for parity. Higher values for udder measurements were correlated with higher milk yield.

Marai *et al.* (2001) studied Buffalo Cow Productive, Reproductive and Udder Traits and Stability under Sub-tropical Environmental Conditions of Egypt. The comparison between the data of the present study (1993 - 1995) and that obtained from a previous one (1983 - 1987) on the same farm, showed decline in all the studied traits. Partial regression coefficients of udder measurements on daily milk yield were significant ($P < 0.01$ or 0.05). The phenotypic correlations between left and right teats, length and diameter of the four teats and distances between the teats were mostly high and positive.

Prasad *et al.* (2010) Studied on the udder measurements as affected by parity in Murrah buffaloes. A positive correlation was found among the udder measurements, viz., udder length, udder width and udder depth and between these measurements and the average daily milk yield. However, the correlation was significant only between udder width and average daily milk yield. A positive correlation existed between the average daily milk yield and the various teat measurements such as teat length, teat diameter and the distance between the front and hind teats. However, the correlation was significant only between average daily milk yield and the teat diameter ($P < 0.01$).

Huseyin *et al.* (2010) determined the relationships between milk ability traits (MT) and some characteristics obtained from Udder scores, milk yield traits and of milk. Study concluded that parity (P), stage of Lactation (SL) and milk yield (MY) were significant on test day milk yield(TDMY). Negative or positive correlations were observed between udder traits and TDMY.

Tag El-Dein *et al.* (2011) classified Ninety-eight Friesian cows were classified in relation to udder shape and teat orifice shape. Also, 18 udder and teat measurements were taken at the different months of lactation. Effects of parity, udder shape and teat orifice shape across the first five lactations and the correlation coefficients (r) were studied. Traits under investigation were lactation period, total milk yield (TMY), 305 day milk yield (305MY). The results were significant and positive correlations ($P < 0.05$); ($P < 0.01$) were shown between TMY and each of udder width.

Lavania *et al.* (2011) results showed that Test day and 100 days milk yield increase up to 3rd lactation. Stage of lactation had significant effect on test days and 100 day milk yield while, non-significant on udder measurement traits udder length, udder width, rear teat circumferences and lateral teat distance were significant on lactation order. The correlation and regression among test day and 100 day milk yield with udder length, udder width and udder depth were positive and non-significant.

Bharti *et al.* (2015) conducted to evaluate the effect of lactation order on morphological traits of teat and udder in Murrah buffaloes. A total of 59 buffaloes were selected for the study which were milked twice daily (morning and evening) by hand milking method. From date of calving to 7th month of lactation, the udder morphological traits viz. teat length, teat diameter, distance between teats, udder dimension, udder depth and height of udder from the ground were recorded fortnightly by using measuring tape and vernier calliper. The teat length (cm) of left fore quarter in 7th lactation order was significantly ($p < 0.05$) higher (9.43 ± 0.19) than first (6.77 ± 0.11), second (7.93 ± 0.07) and third (7.91 ± 0.17) lactation orders.

Thiruvankadan *et al.* (2015) studied the data pertaining to variables production and reproduction traits of 698 murrah buffaloes were collected from central cattle breeding farm Alamadhi, Tamilnadu, India. Study is revealed that parity had a highly significant effect ($P<0.05$) on all the traits studied. Pairwise comparison revealed that the lactation milk yield was lowest in first parity and differed significantly from other parities.

Badekar (2016) studied on the udder and teat morphology and their relationship with milk yield in murrah buffaloes ($n=500$) and it was carried out at the different farms of the Aarey campus of Goregoan (East) of Mumbai district of Maharashtra, Department Of Livestock Production And Management Bombay Veterinary College, Mumbai. Average daily milk yield in Murrah buffalo ranged from 6.50 ± 0.20 to 7.03 ± 0.06 kg. was recorded. The average daily milk yield and lactation yield shows positive correlation with udder width, udder length, average teat length and teat diameter. Lactational yield show high positive correlation with udder width (0.72), average teat diameter (0.77) and average daily milk yield (0.90).

Patel *et al.* (2016) conducted study on udder and teat measurements and their relation with milk production in crossbred cows concluded that the correlations between milk yield and various udder measurements viz., udder length (0.499), udder width (0.413) and udder depth (0.178) were found positive and significant. ($P<0.05$) to highly significant ($P<0.01$).

Modh *et al.* (2017) conducted study on effect of parity on udder and teat biometry and its association with milk yield in gir cows found that the correlations between milk yield and udder width was found positive (0.194) and significant ($P<0.05$) but non-significantly correlated with length and depth. These findings reflected that all the three udder measurements should be the important criteria for selection of dairy cows as the udder length, width and depth decides the capacity of udder which reflects the milk yield.

Hiremath *et al.* (2020) studied the strain-wise udder and teat biometry, lactation milk yield and correlations in (n-256) Deoni cattle. The overall mean lactation milk yield was found to be 1173 ± 33.868 kg. There was no significant effect of strain on any of udder and teat parameters or lactation milk yield.

Ranjitha *et al.* (2021) studied the relationship of Udder Conformation with milk yield, fat and solids-not-fat percent in murrah graded. Founded that average daily milk yield, milk fat and SNF per cent showed positive correlation with all the udder and teat measurement.



Chapter - III

Materials & Methods

CHAPTER III

MATERIAL AND METHODS

The details of the research material used and methodology adopted in this investigation is given hereafter. The present study entitled “Study on Udder and Teat Morphology and its Relationship with milk production in Purnathadi Buffalo” to evaluate the different Udder and teat measurements of Purnathadi buffalo. The data on Purnathadi buffalo individual buffalo generated on farmer’s field in Akola District of Vidharbha region was considered for the study.

The present research design programme was carried out under following sub-heads.

Location of the study

Three tahsil from Akola District i.e. Akola, Akot and Telhara are selected for present study. Akola is a district in the Indian state located in the Amravati division of Maharashtra. Area of the district is 5,428 km². It is bounded on the north and east by Amravati district, to the south by Washim district and to the west by Buldhana district. The Purna river forms the part of north boundary of the district and the top north portion of the district lies within its watershed along with Aas river and Shahnur river.

Geography and climate

Akola is located at latitude 20.7°N and longitude 77.07°E. It is 925 ft (287 m) to 1036 ft (316 m) above sea level, and has a tropical savanna climate bordering humid subtropical climate. Akola has a national weather station that serves as the local weather center. Annual temperature ranges from a high 47.6 °C (117.68 °F) to a low of 2.2 °C (35.96 °F). Akola lies near the Tropic of cancer and becomes very hot during the summer, especially in month of May. The annual rainfall averages 800 millimeters (31 in). Most of the rainfall occurs in the monsoon between June and September, but there is some rainfall in January and February.

Selection of animals

From each village Purnathadi buffaloes with different lactation order (1st to 5th) were selected randomly for present study. Thus, the data on udder and teat measurement and milk yield of total 90 Purnathadi individual female buffaloes was collected by taking actual measurement of each individual in different villages of Akola District of Vidharbha region of Maharashtra.

Tools and Techniques of data collection

The basic instrument for the present study was measuring tape and visual examination. The data were collected by measuring different Udder, Teat traits and Milk Yield also by the visual examination. Efforts have been made to avoid obvious mechanical error, while recording the measurement. Arrangement made to stand the animal on even surface and in normal position at the time of measurement.

Variables and their technique of measurement

All udder measurements of Purnathadi buffaloes were recorded by considering the method used by Bhuiyan *et al.* (2004). The measurements of udder and teat were taken on each animal and were recorded to the nearest centimetre. The measurements were taken with the animal standing squarely, comfortably and evenly on its feet over the hard plain ground. 100 cm long measuring tape with precision of one millimetre, Vernier calliper and measuring metal scales were used for taking required measurements. The similar technique was also recorded by Yosbanis *et al.* (2013). In this study measurement taken into consideration were as follows,

Udder length

Udder length (UL) was measured as a distance from rear attachment of udder below the vagina and moving along udder body up to the fore attachment, where fore udder blends smoothly with the body of the animal. Measuring tape was used to measure the udder length.

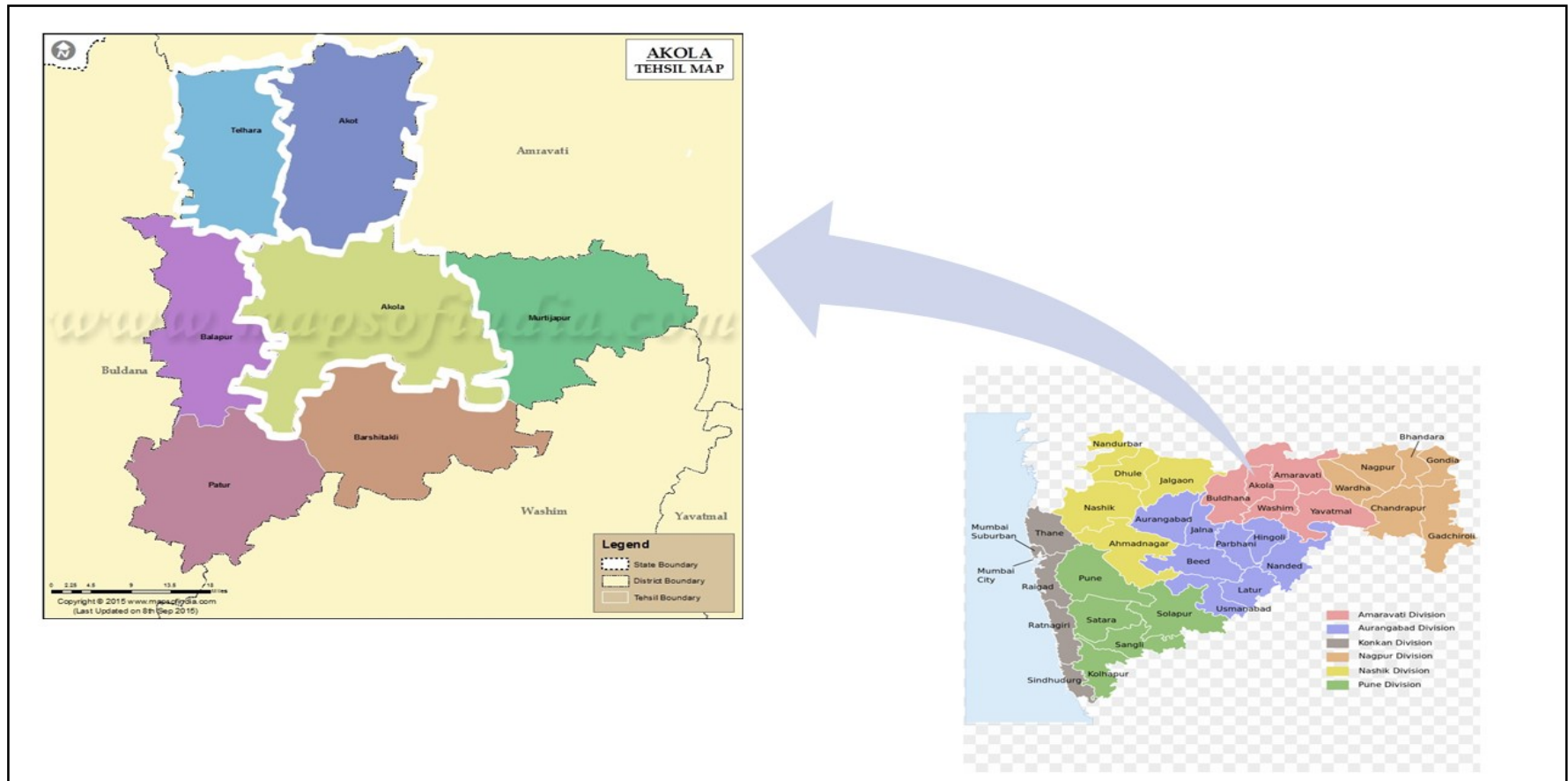


Fig. 3.1 Tehsil wise map of Akola district

Udder width

Udder width (UW) was measured as a distance between widest point of udder near the stifle joint of animal and passing it in between the fore and rear teats, to the widest point of udder near the stifle joint of the other side. Measuring tape was used to measure the udder width.

Udder Depth

Udder depth (UD) was measured as the distance between the roof of udder to the floor of udder. The actual measurement for the depth of udder was measured at lowest hanging point of udder floor. During the actual measurement for udder depth, measuring scale of 30 cm markings was used. The scale was located at upper attachment of udder with inguinal portion parallel to the udder and the lowest hanging point was observed and measured by placing another scale perpendicular to the prior scale. The figure at the junction of both the scales was recorded as the depth of udder in cm.

Teat length

Teat length was measured from the base of teat up to its tip. Considering the uneven size of teats from same animal, the length of all four teats i.e. Front Right (FR), Front Left (FL), Rear Right (RR) and Rear Left (RF) were recorded by using metallic scale of 30 cm size with precision of one millimetre and the overall average teat length of four teat is considered as teat length.

Teat Diameter

Teat diameter (TD) was measured with the help of Vernier caliper. Considering the uneven size of teats from same animal, the diameter of all four teats i.e., Front Right (FR), Front Left (FL), Rear Right (RR) and Rear Left (RF) were recorded and the overall average teat diameter of four teat is considered as teat diameter.

During the actual measurement, Vernier caliper was adjusted to the nearest possible reading followed by holding the teat in between jaws of Vernier caliper. Vernier caliper was moved upwards perpendicular to the length of teat and observed for easy escape of entire teat without any pressure on teat wall by the Vernier caliper. Depending on the observation, readings were adjusted to record most accurate reading for teat diameter. The reading found on Vernier caliper denoted the maximum diameter of that particular teat and recorded for present study.

Qualitative traits:

The qualitative traits like udder shape, and teat shape were recorded by visual observation. To record the shape of Udder, glandular muscular portion of actual udder was considered to categories it in any particular shape, while all four teats were considered for shape.

Milk yield:

Average lactational milk yield:

The average lactational milk yield (Kg) of last lactation of the buffaloes will be recorded by using preformed questionnaire to the buffalo owner and their response will be recorded.

Test day milk yield:

The test day milk yield of the buffaloes will be recorded on the day of visit in morning and evening as per the standard procedure.

Statistical Analysis:

The data generated in present study was standardized, computerised, tabulated and subjected for mean, standard error, one way and two way ANOVA, frequencies, percentage and correlations by using standard procedures given by Snedecor and Cochran (1989). All the statistical analysis was done by using latest version of SPSS (1996) 28.0 software.



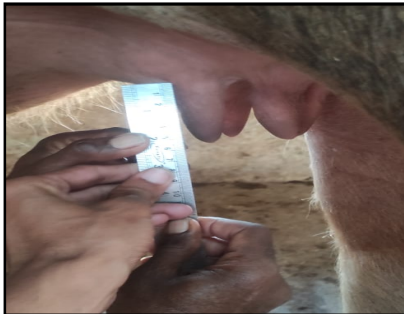
Udder Length



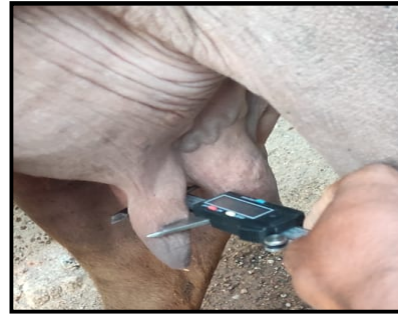
Udder Width



Udder Depth



Teat Length



Teat Width

Plate 3.1 Measurements of Udder and Teat

Purnathadi Buffaloes



Female Buffalo



Buffalo Bull



Buffalo Herd



Calves



Chapter - IV

Results & Discussion



CHAPTER-IV

RESULTS AND DISCUSSION

The present study was undertaken to know the udder, teat morphology and its relationship with milk yield in Purnathadi buffaloes. The results of the present study are discussed as per the objectives of the study under the following headings

4.1 Udder and teat morphology in Purnathadi buffaloes.

4.1.1 Udder Shape

The results of udder shape in the Purnathadi buffaloes under the present study are presented in Table 4.1, and the same is depicted in fig. 4.1 and 4.2. The results showed that the Bowl shape of the udder was more common (54.44%) followed by Round (24.44%), Goaty (13.33%) and Globular shape was found in only 7.78 per cent population under study.

The results of the present study are in agreement with the results of studies conducted by Bainwad *et al.* (2007); they reported prominent Bowl-shaped udders in Marathwadi (44.4%), Surti (41.18%) and Pandharpuri (43.24), Sonwane *et al.* (2002) revealed Bowl, Round and Pendulous shaped udders are common in Marathwadi, Nagpuri, Jafrabadi and Murrah buffaloes, Gubbawar *et al.* (2012) studied udder morphology in Gaolao strain of Nagpuri buffaloes and found that Bowl-shaped udder in the majority (53.4%) followed by Round 38.6% and Goaty (18%) udders, Thalkar *et al.* (2016) reported majority (53.8%) Bowl-shaped udders followed by Round (32.6%) and Goaty (13.6%) in Purnathadi buffaloes, and in Elichpuri buffaloes Bowl (57.4%), Round (24.0%) and Goaty (18.6%). The common occurrence of the Bowl-shaped udders are indicative of farmers' preference for the Bowl-shaped udder for easy milking reason.

Table 4.1: Parity wise overall frequency distribution of different udder shapes in Purnathadi buffaloes

Udder Shape	Parity					Overall	
	1 st	2 nd	3 rd	4 th	5 th & above	Frequency	%
Bowl	7	9	10	11	12	49	54.44
Round	5	4	4	4	5	22	24.44
Goaty	3	3	2	2	2	12	13.33
Globular	1	1	2	1	2	7	7.78
Total	16	17	18	18	21	90	100.00

4.1.2 Udder Length

The results of the udder length of the buffaloes obtained in the present study are presented in Table 4.2 and graphically represented in fig. 4.3. The overall results of udder length for different parity were found to be 39.38 ± 1.00 , 41.79 ± 0.85 , 47.03 ± 0.98 , 52.86 ± 0.97 and 48.86 ± 1.29 cm for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. The overall average udder length irrespective of parity was found to be 46.27 ± 0.68 cm.

The overall results of udder length revealed that there was an increasing trend observed for length of the udder of buffaloes, which increased as parity progressed up to 4th parity. Then it started declining from 5th and above. The differences for udder length were found statistically significant ($P < 0.01$) among buffaloes in 2nd to 4th parity. It is also evident from the results that there was no significant difference in the udder length of buffaloes from different tehsils; however, it differed significantly for parity within tehsils.

Similar to the present findings, the increase and decreasing trend in udder length are also reported by Sangame (2016) for Marathwadi buffalo Prasad *et al.* (2010) for Murrah buffalo. The results of the present study are in

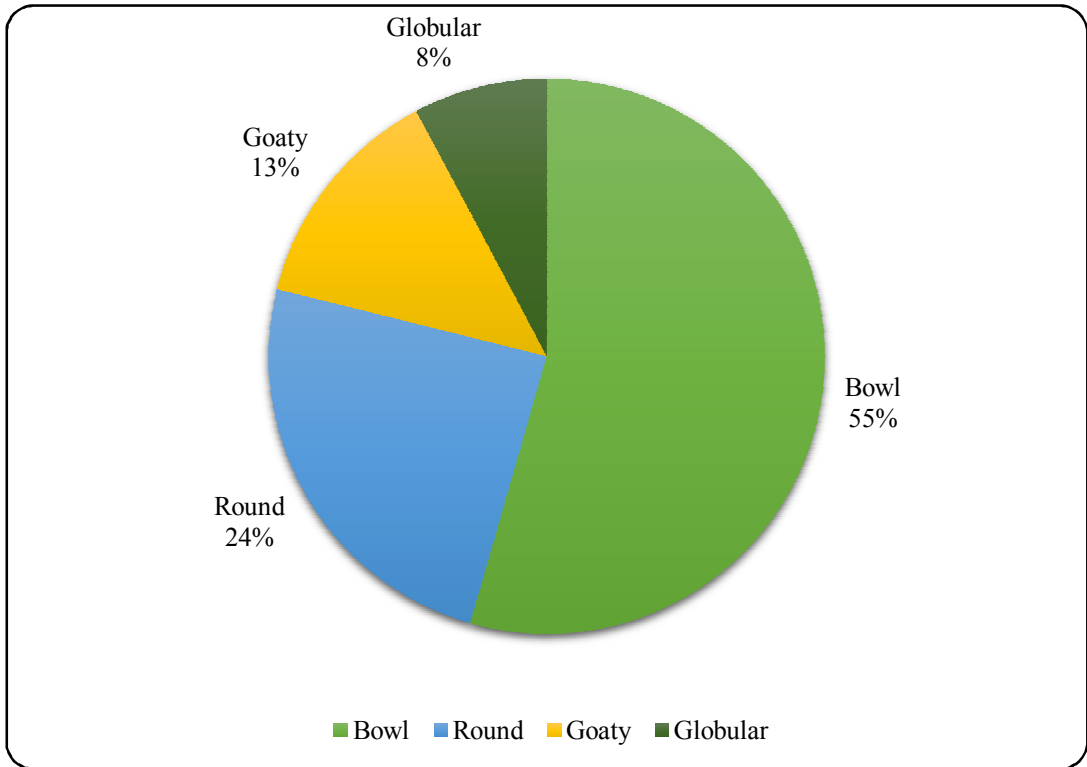


Fig 4.1 Overall distribution of different udder shapes in Purnathadi Buffaloes

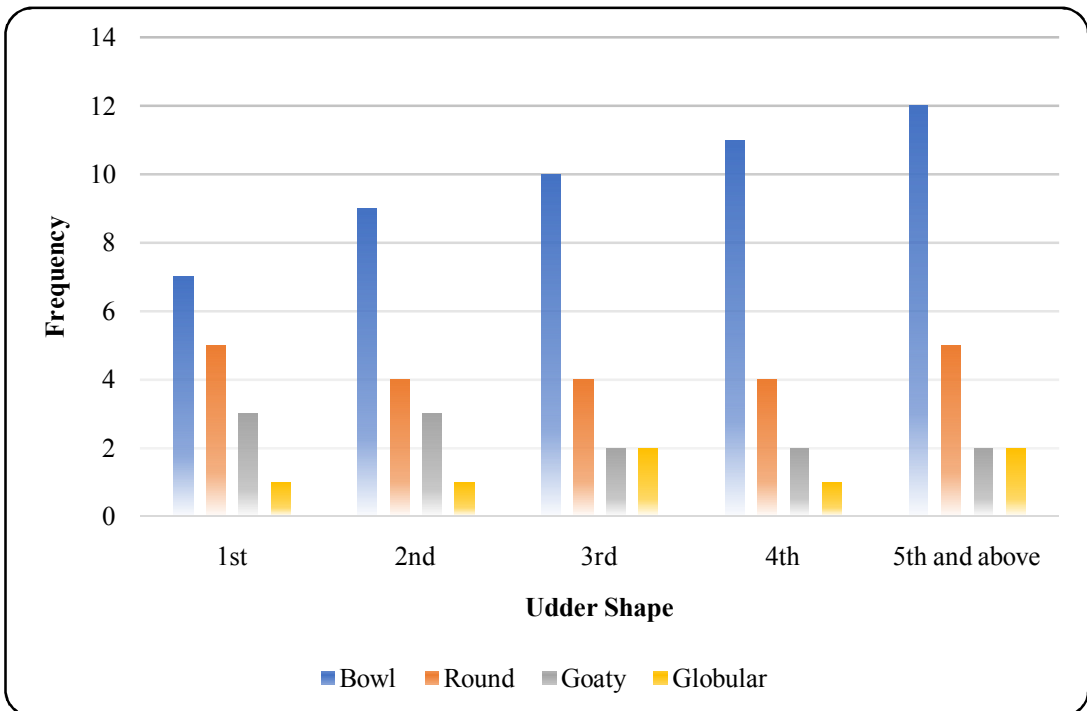


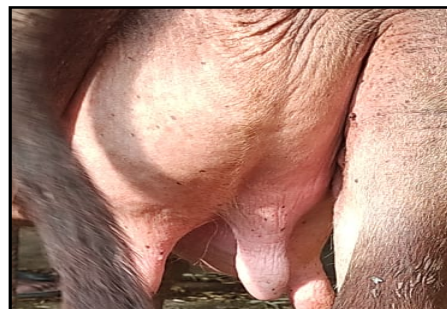
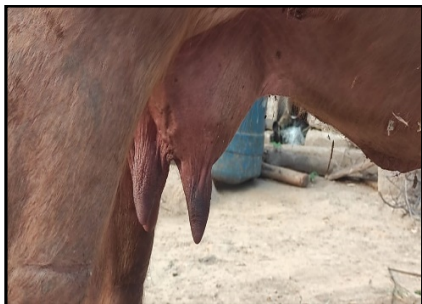
Fig. 4.2 Parity wise distribution of different udder shape in Purnathadi buffaloes



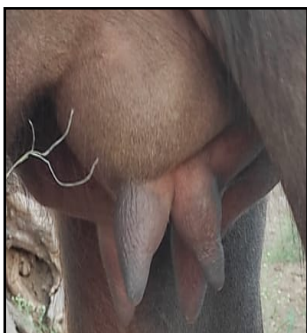
A. Bowl Shape



B. Round Shape



C. Goaty Shape



D. Globular Shape

Plate 4.1 Udder Shapes in Purnathadi Buffaloes

line with the results of Thalkar *et al.* (2016), who observed that the average length of the udder in Purnathadi buffaloes in the age group of 4-5, 5-7, 7-9 and 9-11 years of age group was 39.37±0.55, 42.09±0.64, 48.36±0.33 and 55.30±0.03 cm, respectively, and for the same age group for Elichpuri buffaloes it was found to be 40.57±0.51, 44.40±0.71, 49.65±0.50 and 55.83±0.07 cm, respectively. Gubbawar *et al.* (2012) revealed that irrespective of age, the udder length was ranged between 45.00 to 82.50 cm with an average length of 55.05 cm in the Gaolao strain of Nagpuri buffalo.

Table 4.2 Tehsil and paritywise distribution of udder length (cm) in Purnathadi buffaloes

Parity	Tehsils			Overall
	Akola	Akot	Telhara	
1 st	38.67 ^a ±0.65	36.58 ^a ±0.69	44.63 ^{ab} ±2.11	39.38 ^a ±1.00
2 nd	43.36 ^b ±1.83	41.10 ^b ±0.83	40.30 ^a ±0.73	41.79 ^a ±0.85
3 rd	46.10 ^b ±0.97	45.83 ^c ±0.75	48.71 ^{bc} ±2.31	47.03 ^b ±0.98
4 th	52.08 ^c ±1.00	50.90 ^d ±1.09	54.93 ^c ±2.08	52.86 ^c ±0.97
5 th & above	51.83 ^c ±2.47	48.44 ^{cd} ±1.92	46.79 ^{bc} ±2.29	48.86 ^b ±1.29
Total	46.32±1.16	44.73±1.10	47.77±1.26	46.27±0.68

The means bearing ^{a,b,c} superscript within column differs significantly (P<0.01).

The means bearing superscripts ^{e,f,g} within row differs significantly (P<0.05)

4.1.3 Udder width

The results of udder width are presented in Table 4.3 and depicted in fig. 4.4. The overall results of udder width for different parity were found to be 33.25±0.66, 34.71±0.60, 38.14±0.57, 39.31±0.58 and 39.48±0.66 cm for 1st, 2nd, 3rd, 4th and ≥ 5th parity, respectively. The overall average udder width irrespective of parity was found to be 37.17±0.38 cm.

The results of the overall average udder width of the buffaloes showed that the udder width of the buffaloes was comparable between different parities. There was a progressive increase in the udder width of the buffaloes up to 4th parity and stagnated thereon.

The udder width of 1st and 2nd parity differed significantly ($P<0.01$) with the 3rd, 4th and $\geq 5^{\text{th}}$ parity. However, there was no significant difference observed between 1st and 2nd parity and between 3rd, 4th and $\geq 5^{\text{th}}$ parities. The results of the tehsil wise comparison of buffaloes for udder width were also statistically nonsignificant.

The present study results concur with the Prasad *et al.* (2010) they reported an increase in the udder width from 1st to 3rd lactation in Murrah buffaloes. Present findings are also supported by the findings of Thalkar *et al.* (2016) for Purnathadi and Elichpuri buffaloes and Tayade *et al.* (2010) for Gaolao buffalo, and they reported the progressive increase in the udder width up to 11 years of age which is up to 5th parity considering the 3.5 to 4 years age at first calving in these buffaloes which are from the same region of the present study.

Table 4.3 Tehsil and paritywise distribution of udder width (cm) in Purnathadi buffaloes

Parity	Tehsil			Overall
	Akola	Akot	Telhara	
1 st	33.25 ^a ±0.78	31.33 ^a ±0.36	36.13 ^{ab} ±1.48	33.25 ^a ±0.66
2 nd	35.50 ^{ab} ±1.25	34.10 ^b ±0.53	34.20 ^a ±0.98	34.71 ^a ±0.60
3 rd	38.70 ^{bc} ±1.57	38.25 ^c ±0.91	37.64 ^{bc} ±0.72	38.14 ^b ±0.57
4 th	39.33 ^c ±1.11	38.90 ^c ±0.99	39.57 ^c ±1.02	39.31 ^b ±0.58
5 th & Above	41.92 ^c ±1.23	38.88 ^c ±1.08	38.07 ^{bc} ±0.72	39.48 ^b ±0.66
Total	41.92±0.76	36.45±0.68	37.42±0.51	37.17±0.38

The means bearing ^{a,b,c} superscript within column differs significantly ($P<0.01$).

The means bearing superscripts ^{e,f,g} within row differs significantly ($P<0.05$)

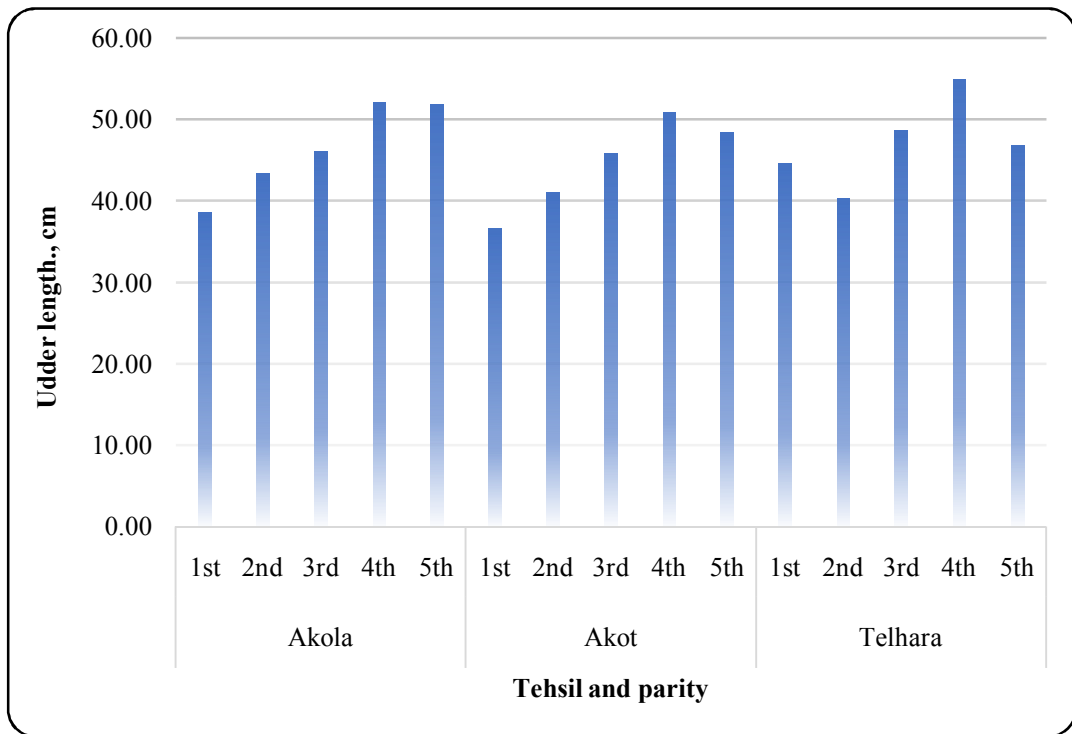


Fig.4.3 Tehsil and paritywise Udder Length of Purnathadi buffaloes

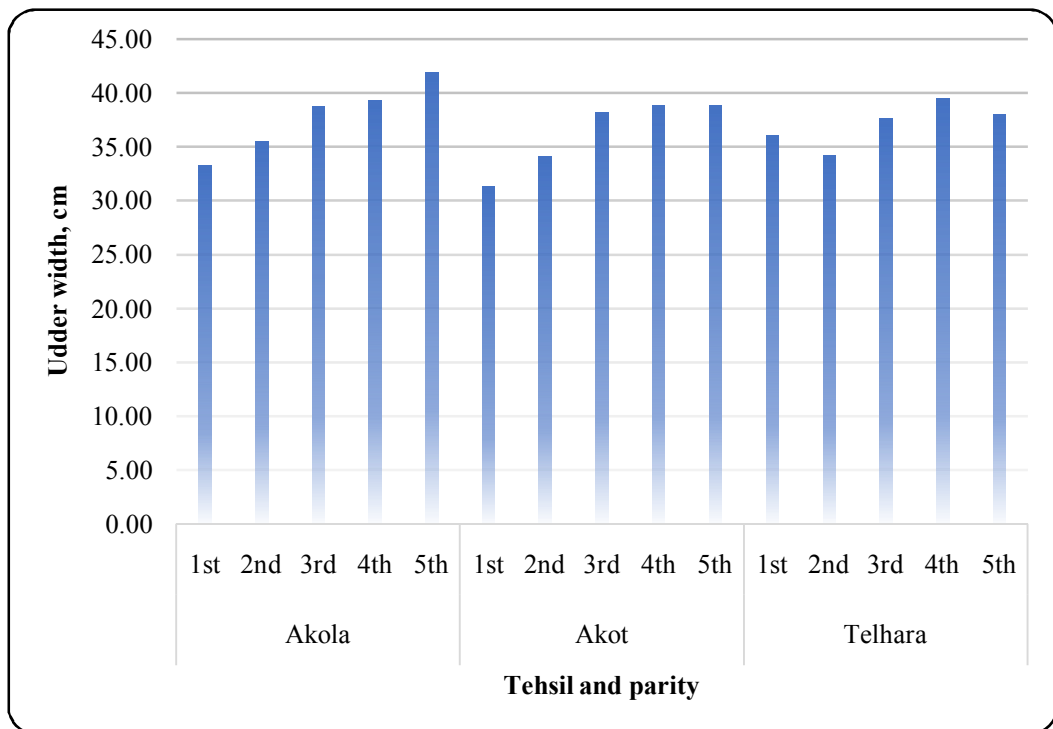


Fig.4.4 Tehsil and Paritywise Udder Width of Purnathadi buffaloes

4.1.4 Udder depth

The results of the udder depth are presented in Table 4.4 and depicted in fig. 4.5. The overall results of udder width for different parity were found to be 8.38 ± 0.40 , 9.53 ± 0.40 , 10.39 ± 0.36 , 11.25 ± 0.49 and 10.50 ± 0.42 cm for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. The overall average udder depth irrespective of parity was found to be 10.07 ± 0.21 cm.

The overall results of the udder depth revealed an increase in udder depth with progression in parity from 1st to 4th thereon it declined in 5th and above parity. It was also found that there was no significant difference in the udder depth of buffaloes between different tehsils.

The results of the present study are in line with the results of Sangame (2016), who reported average udder depth in Marathwada buffalo at 1st, 2nd, 3rd, 4th and above lactations were 8.39 ± 0.09 , 10.19 ± 0.12 , 11.38 ± 0.14 , 12.29 ± 0.08 and 11.03 ± 0.08 cm, respectively. Ranjitha *et al.* (2021) revealed the overall average udder depth of 11.8 ± 0.05 in graded Murrah buffaloes. Similar to the present study's findings, Prasad *et al.* (2010) reported an increase in udder depth from 1st to 3rd lactation in Murrah buffalo; however, the depth of the udder was quite greater, i.e., 15 cm compared to the present results. The differences in the average udder depth in the present study might be due to the breed.

Table 4.4 Tehsil and paritywise distribution of udder depth (cm) in Purnathadi buffaloes

Parity	Tehsil			Overall
	Akola	Akot	Telhara	
1 st	8.42 ^a ±0.44	7.92 ^a ±0.65	9.00 ^a ±1.17	8.38 ^a ±0.40
2 nd	10.21 ^{ab} ±0.68	9.10 ^{ab} ±0.80	9.00 ^a ±0.57	9.53 ^b ±0.40
3 rd	10.10 ^{ab} ±0.68	11.17 ^c ±0.54	9.93 ^a ±0.62	10.39 ^{bc} ±0.36
4 th	11.17 ^c ±0.88	9.90 ^{bc} ±0.40	12.29 ^b ±0.86	11.25 ^c ±0.49
5 th & Above	12.42 ^c ±0.61	10.06 ^{bc} ±0.51	9.36 ^a ±0.61	10.50 ^{bc} ±0.42
Total	10.47±0.37	9.67±0.32	10.07±0.39	10.07±0.21

The means bearing ^{a,b,c} superscript within column differs significantly (P<0.01).

The means bearing superscripts ^{e,f,g} within row differs significantly (P<0.05)

4.1.5 Teat Shape

The results of the teat shape of Purnathadi buffaloes under the present study are presented in table 4.5 and graphically represented in figs 4.6 and 4.7. The findings of the present study revealed that the majority (57.78%) of buffaloes possessed Cylindrical shaped teats followed by Pear (16.67%), Conical (14.44%), Bottle (7.78%) and Funnel (3.33%). Similar findings are also reported by several researchers Rao and Murthy (1991) and Badekar (2016) in Murrah buffaloes, Bainwad *et al.* (2007) in Marathwadi, Surti and Pandharpuri buffaloes. These findings suggest that the cylindrical teat shape is most common among buffaloes.

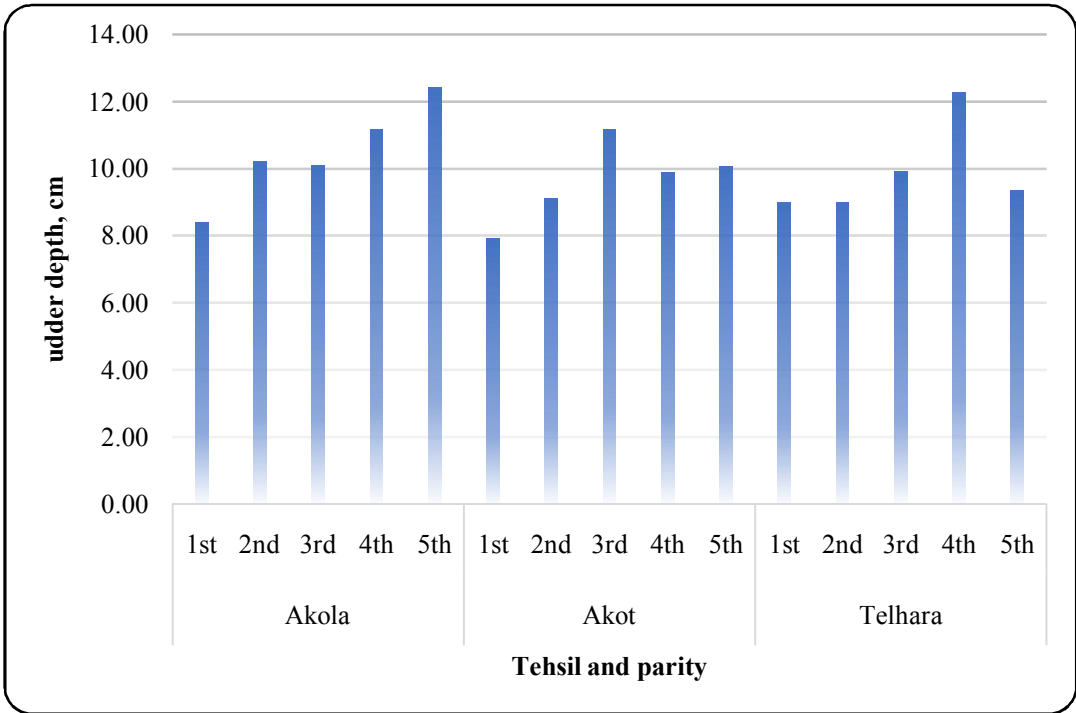


Fig.4.5 Tehsil and Paritywise Udder Depth of Purnathadi buffaloes

Table 4.5 Parity wise overall distribution of different teat shapes in Purnathadi buffaloes

Teat Shape	Parity					Overall	
	1 st	2 nd	3 rd	4 th	5 th & above	Frequency	%
Cylindrical	8	8	11	12	13	52	57.78
Conical	3	4	3	1	2	13	14.44
Pear	3	4	2	3	3	15	16.67
Bottle	2	1	2	2	0	7	7.78
Funnel	0	0	0	0	3	3	3.33
Total	16	17	18	18	21	90	100.00

4.1.6 Teat length

The results of the teat length of Purnathadi buffaloes under the present study are presented in Table 4.6 and depicted in fig. 4.8. The teat length was found to be 4.86 ± 0.14 , 5.55 ± 0.17 , 6.07 ± 0.16 , 6.69 ± 0.22 , 6.26 ± 0.18 cm for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity buffaloes, respectively. The overall teat length in the present study was found to be 5.92 ± 0.10 cm. The results revealed that there was parity wise significant ($P < 0.01$) difference in teat length among the buffaloes under the present study. However, teat length in buffaloes did not differ significantly among different tehsils. The teat length was observed to be increased significantly ($P < 0.01$) as the parity progressed up to the 4th parity and then started declining. The present findings are in line with Sangame (2016) results, who reported similar teat lengths in Marathwadi buffaloes, and Prasad *et al.* (2010) also observed a significant increase in teat length as parity progressed up to 4th parity and then declined. Gubbawar *et al.* (2012) observed an average teat length irrespective of age group varied from 10.0 to 20.0 cm with an average value of 16.87 cm in the Gaolao strain of Nagpuri buffalo. The difference in the teat length in the present study might be occurred due to breed differences.

Table 4.6 Tehsil and paritywise distribution of teat length (cm) in Purnathadi buffaloes

Parity	Tehsil			Overall
	Akola	Akot	Telhara	
1 st	4.65 ^a ±0.33	4.95 ^a ±0.18	5.05 ^a ±0.12	4.86 ^a ±0.14
2 nd	5.59 ^b ±0.24	5.54 ^{ab} ±0.36	5.52 ^{ab} ±0.36	5.55 ^b ±0.17
3 rd	6.00 ^b ±0.34	6.23 ^b ±0.26	5.97 ^{bc} ±0.26	6.07 ^{bc} ±0.16
4 th	6.78 ^c ±0.48	6.68 ^b ±0.52	6.61 ^{bc} ±0.25	6.69 ^c ±0.22
5 th & Above	6.03 ^b ±0.24	6.59 ^b ±0.39	6.07 ^c ±0.21	6.26 ^{bc} ±0.18
Total	5.80±0.19	6.03±0.19	5.95±0.14	5.92±0.10

The means bearing ^{a,b,c} superscript within column differs significantly (P<0.01).

The means bearing superscripts ^{e,f,g} within row differs significantly (P<0.05)

4.1.7 Teat width

The results of the teat width of Purnathadi buffaloes under the present study are presented in Table 4.7 and depicted in fig. 4.9. The teat width was found to be 2.41±0.10, 2.76±0.13, 4.11±0.34, 3.80±0.13 and 3.60±0.10 cm for 1st, 2nd, 3rd, 4th and ≥5th parity, respectively. The overall average teat width in the present study was found to be 3.37±0.10. The present study results revealed that the teat width was differed significantly (P<0.01) among different parities. Also, it was found that the teat width was differed significantly (P<0.05) among different tehsils.

The overall results indicated that the teat width was increased progressively till 3rd parity and then started declining onwards; similar results were also reported by Sangame (2016), who reported a progressive increase in teat width in Marathwadi buffaloes upto 4th lactation and then started declining. Prasad *et al.* (2010) studied the teat diameter in Murrah buffaloes and reported a significant (P<0.05) increase in the teat diameter with progressed parity upto 4th parity and then started to decline.

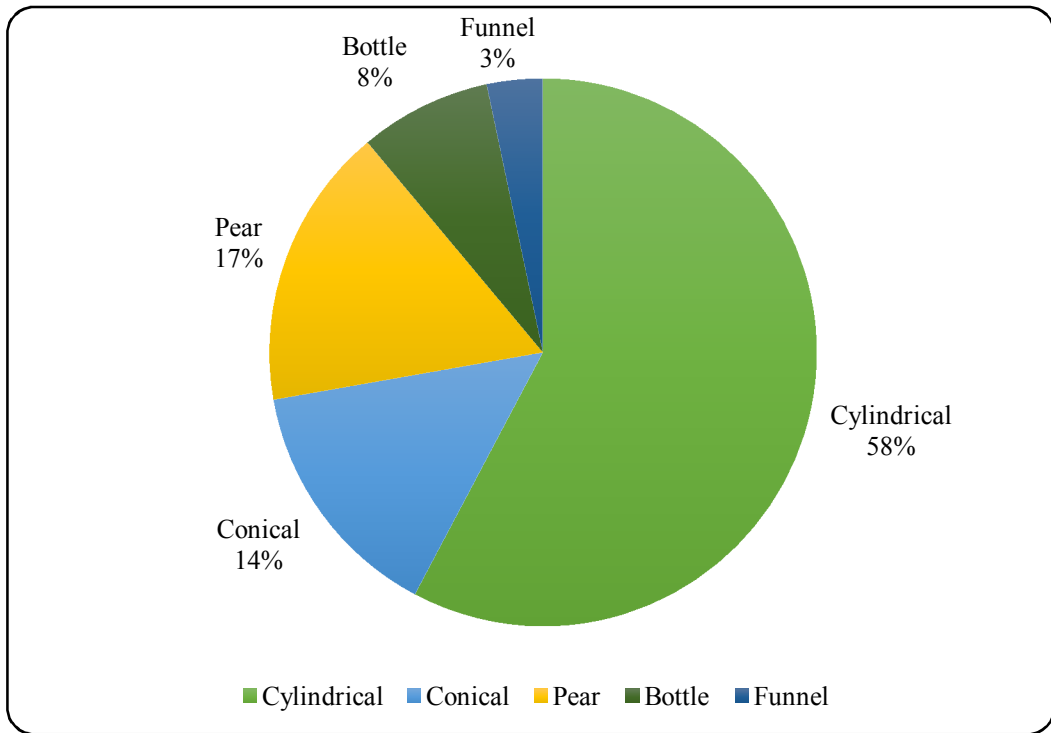


Fig 4.6 Overall distribution of different teat shape in Purnathadi buffaloes

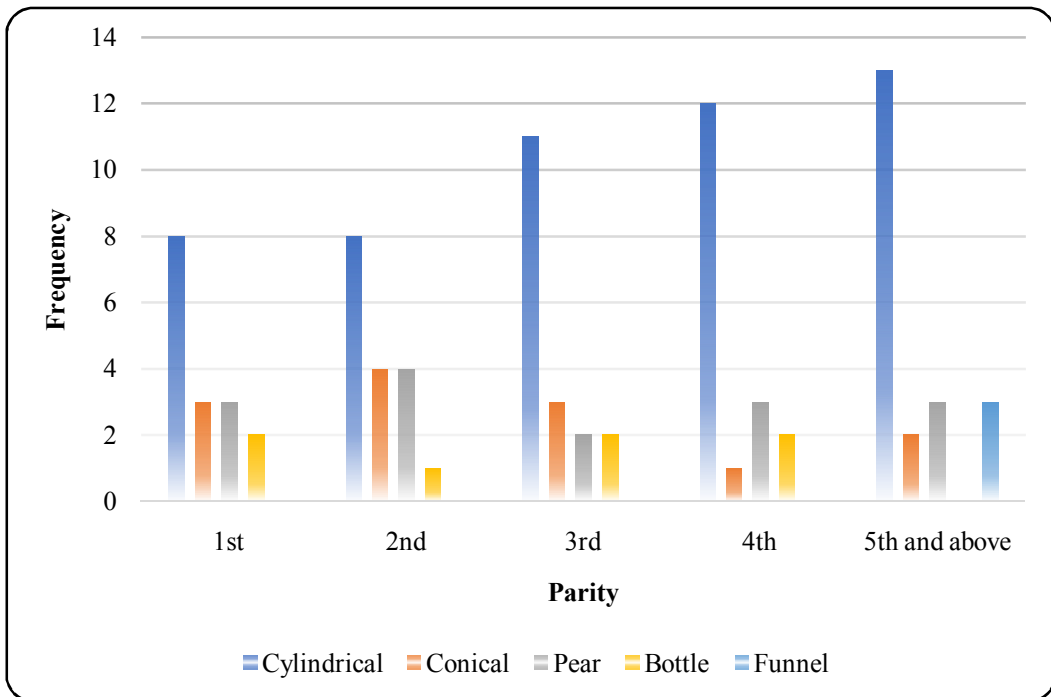


Fig 4.7 Parity wise distribution of different teat shape in Purnathadi buffaloes

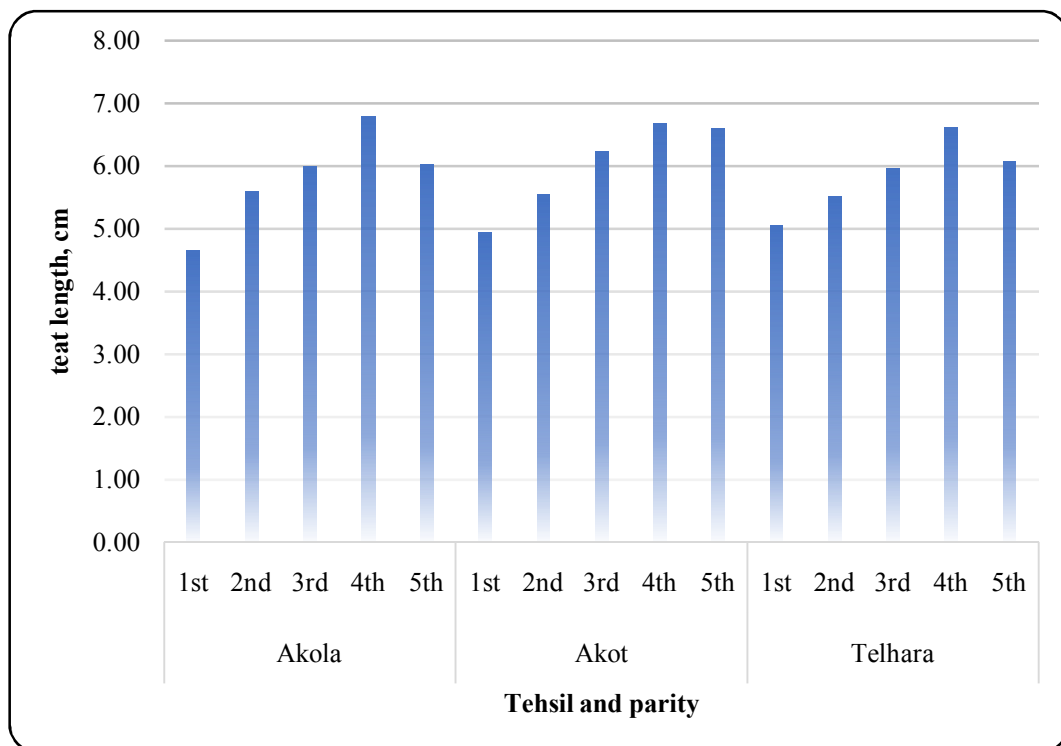


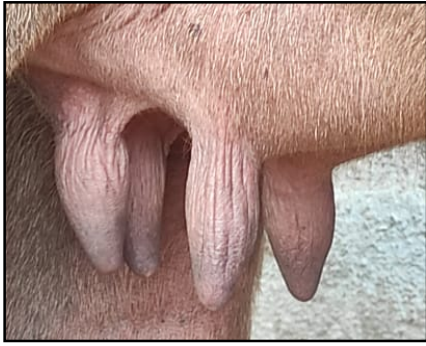
Fig.4.8 Tehsil and Paritywise Teat Length of Purnathadi buffaloes



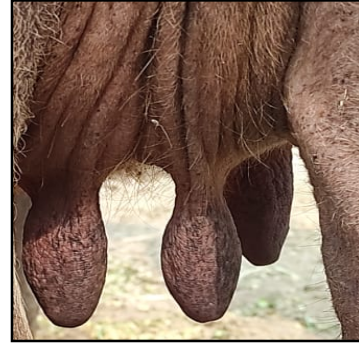
A. Cylindrical shape



B. Conical shape



C. Pear shape



D. Bottle shape



E. Funnel Shape

Plate 4.2 Teat Shapes in Purnathadi Buffaloes

Table 4.7 Tehsil and paritywise distribution of teat width (cm) in Purnathadi buffaloes

Parity	Tehsil			Overall
	Akola	Akot	Telhara	
1 st	2.60 ^a ±0.18	2.15 ^a ±0.03	2.50 ^a ±0.27	2.41 ^a ±0.10
2 nd	2.99 ^{ab} ±0.17	2.50 ^a ±0.22	2.70 ^a ±0.27	2.76 ^a ±0.13
3 rd	3.26 ^b ±0.43	3.48 ^b ±0.27	5.26 ^b ±0.57	4.11 ^c ±0.34
4 th	3.53 ^c ±0.23	3.72 ^b ±0.15	4.09 ^c ±0.24	3.80 ^{bc} ±0.13
5 th & Above	3.47 ^{bc} ±0.18	3.79 ^b ±0.14	3.49 ^{ab} ±0.21	3.60 ^b ±0.10
Total	3.16^e±0.12	3.17^e±0.14	3.78^f±0.24	3.37±0.10

The means bearing ^{a,b,c} superscript within column differs significantly (P<0.01).
The means bearing superscripts ^{e,f,g} within row differs significantly (P<0.05)

4.2 Milk production parameters

4.2.1 Test Day Milk Yield (TDMY)

The results of the test day milk yield of the Purnathadi buffaloes under the present study are presented in Table 4.8 and depicted in fig 4.10. The TDMY of Purnathadi buffaloes was found to be 4.03±0.33, 5.06±0.34, 6.19±0.42, 6.22±0.48 and 5.88±0.45 kg for 1st, 2nd, 3rd, 4th and ≥5th parity, respectively. The present findings of TDMY were comparable and differed significantly (P<0.01) among different parities. It was found that the TDMY was increased significantly upto 4th parity and then started declining in 5th and above.

The present result showed an average TDMY is 5.53±0.20 was closely related result obtained by Hamand *et al.* (2019); they reported the average daily milk yield of Shahi strain of Nagpuri buffaloes was 4.06±0.08 kg. Also, Mishra *et al.* (2017) revealed the average daily milk yield of Pandharpuri buffalo is 4.90 litre. Badekar (2016) reported average daily milk yield in

Murrah buffalo ranged from 6.50±0.20 to 7.03±0.06 kg. Kushwaha *et al.* (2013) reported average daily milk yield in Bhadawari buffaloes was 4.30±0.06 kg.

Table 4.8 Test day milk yield (kg) of Purnathadi buffaloes.

Parity	Tehsil			Overall
	Akola	Akot	Telhara	
1 st	3.63 ^a ±0.43	4.63±0.69	3.73 ^a ±0.49	4.03 ^a ±0.33
2 nd	4.44 ^{ab} ±0.44	6.38±0.54	4.62 ^{ab} ±0.52	5.06 ^{ab} ±0.34
3 rd	6.74 ^c ±0.72	5.58±0.61	6.31 ^{ab} ±0.83	6.19 ^b ±0.42
4 th	6.57 ^c ±0.73	5.42±0.66	6.50 ^b ±1.00	6.22 ^b ±0.48
5 th & Above	5.98 ^{bc} ±0.89	5.96±0.78	5.69 ^{ab} ±0.79	5.88 ^b ±0.45
Total	5.40±0.35	5.60±0.31	5.58±0.39	5.53±0.20

The means bearing ^{a,b,c} superscript within column differs significantly (P<0.01).
The means bearing superscripts ^{e,f,g} within row differs significantly (P<0.05)

4.2.2 Lactational milk yield (LMY)

The results of the lactational milk yield of the Purnathadi buffaloes under the present study are presented in Table 4.9 and depicted in fig 4.10. The LMY of Purnathadi buffaloes was found to be 1133.76±49.96, 1292.11±38.95, 1294.33±30.74 and 1277.38±35.41 kg for 2nd, 3rd, 4th and ≥5th parity, respectively. The present findings of LMY were comparable and differed significantly (P<0.05) among different parities. The results of the study revealed that the lactation yield of the buffaloes was increased as parity progressed. However, the LMY was increased significantly (P<0.05) upto 3rd parity only. The average lactational milk yield in Purnathadi buffaloes was found to be 1252.09±20.51.

The similar finding about average lactational milk yield reported by Hamand *et al.* (2019), they revealed the average lactational milk yield per lactation of Shahi strain of Nagpuri buffaloes was 1,220.84±41.57 kg.

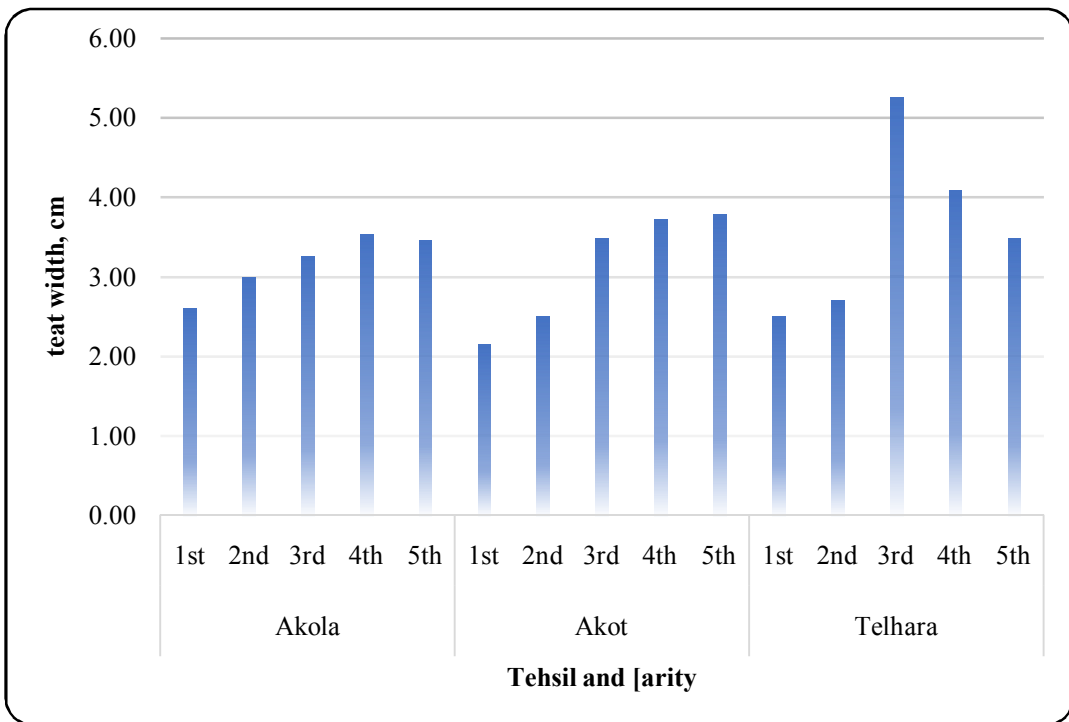


Fig.4.9 Tehsil and Paritywise Teat Width of Purnathadi buffaloes

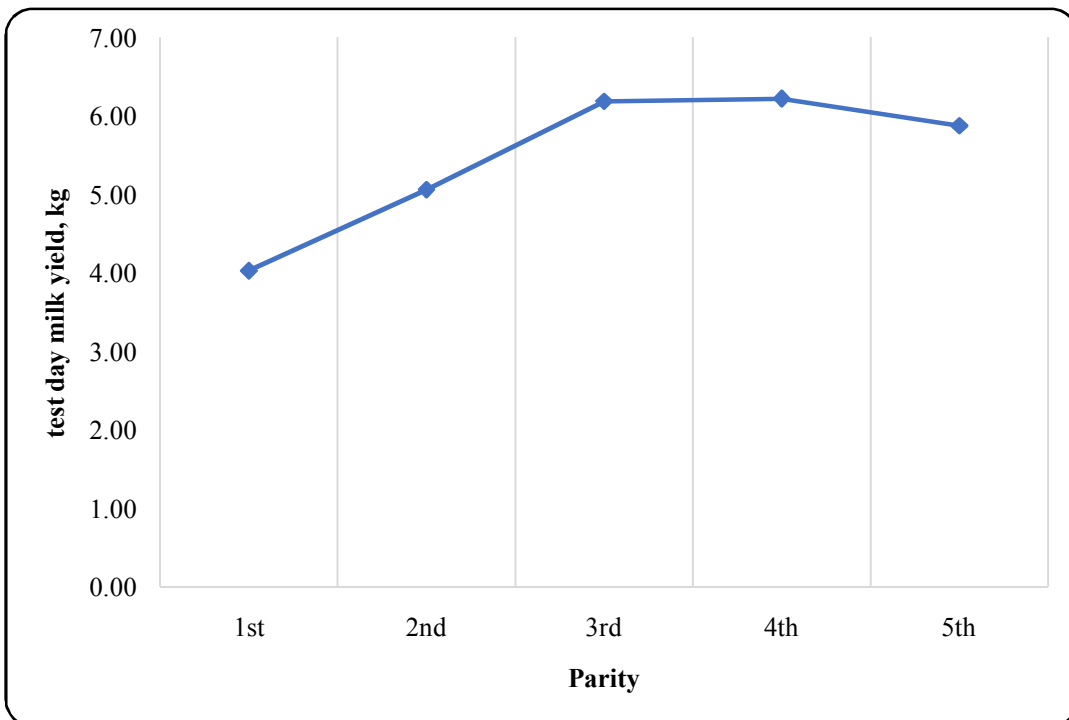


Fig.4.10 Paritywise Test Day Milk Yield of Purnathadi buffaloes

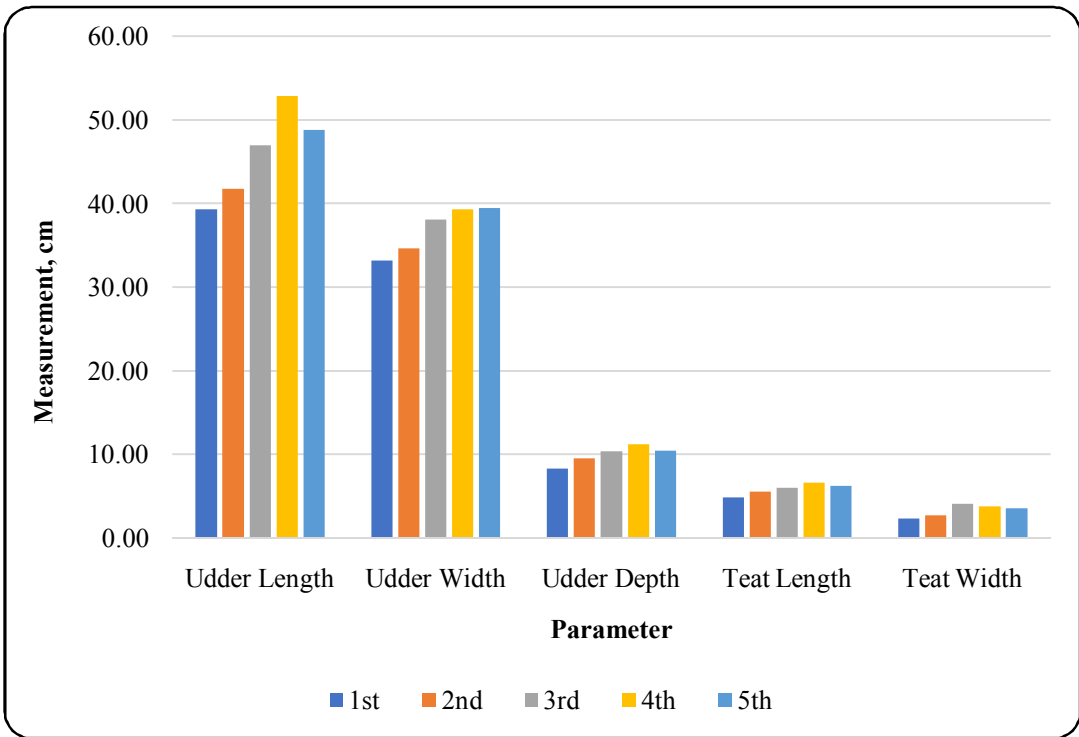


Fig.4.11 Overall Paritywise Udder and Teat morphology of Purnathadi buffaloes

Panicker *et al.* (2016) found 1230.46±17.93 kg. average 305 days milk yield in Nagpuri buffalo. Mishra *et al.* (2007) revealed 1207.70 kg. average lactational milk yield in Pandharpuri buffaloes. Kushwaha *et al.* (2013) revealed that average lactational milk yield of 1250±24.6 kg in Bhadawari buffaloes.

Table 4.9 Lactational milk yield (kg) of Purnathadi buffaloes.

Parity	N	Milk yield
2nd	17	1133.76 ^a ±49.96
3rd	18	1292.11 ^b ±38.95
4th	18	1294.33 ^b ±30.74
5 th & Above	21	1277.38 ^b ±35.41
Total	74	1252.09±20.51

The means bearing ^{a,b,c} superscript within column differs significantly (P<0.05).

4.3 Relationship of udder and teat morphology with test day milk yield and lactation yield in Purnathadi buffaloes.

4.3.1 Relationship between udder and teat morphology with Test day milk yield

The results of the correlations of udder morphology with Test day milk yield in Purnathadi buffaloes are presented in Table 4.10. The results of the correlation revealed that the relationship of the udder length (r=0.322), udder width (r=0.277), udder depth(r=0.272), Teat width (r=0.276) with TDMY were positive and highly significant (P<0.01); however, positive but nonsignificant relationship was found between teat length (r=0.119) and TDMY.

The positive relationship of all the udder and teat morphometric parameters with TDMY under the present study indicated that an increase in the TDMY is closely associated with an increase in the udder morphometric parameters. Similarly, Prasad *et al.* (2010) reported a positive correlation among the udder length, udder width and udder depth with the average daily

milk yield. Also, they found a positive correlation between the average daily milk yield and the various teat measurements such as teat length, teat diameter in Murrah buffaloes. Similarly Ranjitha *et al.* (2021) reported positive correlation between average daily milk yield with all the udder and teat measurements.

4.3.2 Relationship between udder and teat morphology with Lactational milk yield

The correlations of udder morphology with lactational milk yield in Purnathadi buffaloes are presented in Table 4.10. The results of the correlation revealed that the relationship of the udder length ($r=0.286$), udder width ($r=0.278$), udder depth ($r=0.276$), with LMY was found to be positive and significant ($P<0.05$); however, a positive but nonsignificant relationship was found between teat length ($r=0.042$) and Teat width ($r=0.194$) with LMY.

The positive relationship of all the udder and teat morphometric parameters with LMY under the present study indicated that an increase in the TDMY is associated with an increase in the udder morphometric parameters. Similarly, Patel *et al.* (2016) concluded that the correlations between milk yield and various udder measurements viz., udder length (0.499), udder width (0.413) and udder depth (0.178) were found positive and significant. ($P<0.05$) to highly significant ($P<0.01$).

4.3.3 Relationship between udder and teat morphology, TDMY and LMY with Parity

The results of the correlations of udder morphology with parity in Purnathadi buffaloes are presented in Table 4.10. The results of the correlation revealed that the relationship of the udder length ($r=0.635$), udder width ($r=0.663$), udder depth ($r=0.406$), Teat width ($r=0.465$) and TDMY ($r=0.341$) with parity was found to be positive and highly significant ($P<0.01$) with the Parity, and also positive and significant ($P<0.05$) relationship was found between LMY ($r=0.262$) and Parity. However, there was a positive but

nonsignificant relationship was found between teat length ($r=0.152$) with the Parity.

These results indicated that progression in Parity had a positive effect on udder and teat morphometry; similarly, Patel *et al.* (2016) concluded that gradual increase in udder length width and depth also found a gradual increase in teat length with the advancement of parity in a crossbred cow. Prasad *et al.* (2010) for Murrah buffalo, there was an increase in udder length, width and depth from first to the third lactation, and also there was an increase in size and diameter of teats from the first to third lactation. Huseyin *et al.* (2010) concluded that parity (P), stage of Lactation (SL), and milk yield (MY) was significant on test day milk yield(TDMY). Negative or positive correlations were observed between udder traits and test day milk yield (TDMY).

Table 4.10 Correlations of udder and teat morphology with Test day milk yield and Lactational Milk yield.

Correlations									
		Parity	Udder Length	Udder Width	Udder Depth	Teat Length	Teat Width	TDMY	LMY
Parity	Pearson Correlation	1	.635**	.663**	.406**	0.152	.465**	.341**	.262*
	Sig. (2-tailed)		0.000	0.000	0.000	0.152	0.000	0.001	0.024
	N	90	90	90	90	90	90	90	74
Udder Length	Pearson Correlation	.635**	1	.738**	.675**	0.149	.536**	.322**	.286*
	Sig. (2-tailed)	0.000		0.000	0.000	0.160	0.000	0.002	0.014
	N	90	90	90	90	90	90	90	74
Udder Width	Pearson Correlation	.663**	.738**	1	.674**	0.077	.416**	.277**	.278*
	Sig. (2-tailed)	0.000	0.000		0.000	0.470	0.000	0.008	0.016
	N	90	90	90	90	90	90	90	74
Udder Depth	Pearson Correlation	.406**	.675**	.674**	1	-0.056	.376**	.272**	.276*
	Sig. (2-tailed)	0.000	0.000	0.000		0.603	0.000	0.009	0.018
	N	90	90	90	90	90	90	90	74
Teat Length	Pearson Correlation	0.152	0.149	0.077	-0.056	1	0.069	0.119	0.042
	Sig. (2-tailed)	0.152	0.160	0.470	0.603		0.518	0.264	0.721
	N	90	90	90	90	90	90	90	74
Teat Width	Pearson Correlation	.465**	.536**	.416**	.376**	0.069	1	.276**	0.194
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.518		0.009	0.097
	N	90	90	90	90	90	90	90	74
TDMY	Pearson Correlation	.341**	.322**	.277**	.272**	0.119	.276**	1	.728**
	Sig. (2-tailed)	0.001	0.002	0.008	0.009	0.264	0.009		0.000
	N	90	90	90	90	90	90	90	74
LMY	Pearson Correlation	.262*	.286*	.278*	.276*	0.042	0.194	.728**	1
	Sig. (2-tailed)	0.024	0.014	0.016	0.018	0.721	0.097	0.000	
	N	74	74	74	74	74	74	74	74
** . Correlation is significant at the 0.01 level (2-tailed).									
* . Correlation is significant at the 0.05 level (2-tailed).									



Chapter - V

Summary & Conclusions

CHAPTER V

SUMMARY AND CONCLUSIONS

The present study entitled "Study on Udder and Teat Morphology and its relationship with milk yield in Purnathadi Buffalo" was undertaken to know the Udder and Teat morphology and its relationship with the milk yield in Purnathadi buffaloes. The study was carried out in three tehsils from the breeding tract of Purnathadi buffaloes, where the population of these buffaloes is concentrated. A total of 30 buffaloes were selected randomly from each tehsil, and parameters viz. udder shape, udder length, udder width, udder depth were recorded to study the udder morphology, while teat shape, teat length and teat width were recorded to study the teat morphology. The collected raw data was computerised and put to statistical analysis using statistical methods like mean, standard error, one way and two way ANOVA, frequency, percentage, etc. The analysis was done using SPSS statistics 28.0. The results were drawn and interpreted. The results obtained are summarised as below.

5.1 Udder morphology of Purnathadi buffaloes:

Udder Shape

The results indicated that the Bowl-shaped udder was more common (54.44%) followed by Round (24.44%), Goaty (13.33%) and Globular shape was found in only 7.78 per cent population under study.

Udder length

The overall results of udder length for different parity were found to be 39.38 ± 1.00 , 41.79 ± 0.85 , 47.03 ± 0.98 , 52.86 ± 0.97 and 48.86 ± 1.29 cm for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. The overall average udder length irrespective of parity was found to be 46.27 ± 0.68 cm. These results indicated that the udder length was increased as parity progressed up to 4th parity, and then it started declining from 5th and above.

Udder width

The overall results of udder width for different parity were found to be 33.25 ± 0.66 , 34.71 ± 0.60 , 38.14 ± 0.57 , 39.31 ± 0.58 , 39.48 ± 0.66 and 48.86 ± 1.29 cm for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. The overall average udder width irrespective of parity was found to be 37.17 ± 0.38 cm. There was a progressive increase in the udder width of the buffaloes up to 4th parity and stagnated thereon. However, the udder width was found to be significantly ($P<0.01$) increased from 2nd to 3rd parity only.

Udder depth

The overall results of udder depth for different parity were found to be 8.38 ± 0.40 , 9.53 ± 0.40 , 10.39 ± 0.36 , 11.25 ± 0.49 and 10.50 ± 0.42 cm for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. The overall average udder depth irrespective of parity was found to be 10.07 ± 0.21 cm. The study revealed that there was an increase ($P<0.01$) in udder depth as parity progressed upto 4th parity and then declined from 5th and above.

5.2 Teat Morphology

Teat Shape

It was revealed that the majority (57.78%) buffaloes possessed Cylindrical shaped teats followed by Conical (14.44%), Pear (16.67%), Bottle (7.78%) and Funnel (3.33%). These findings suggest that the cylindrical teat shape is most common among buffaloes.

Teat length

The teat length was found to be 4.86 ± 0.14 , 5.55 ± 0.17 , 6.07 ± 0.16 , 6.69 ± 0.22 , 6.26 ± 0.18 cm for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. The overall teat length in the present study was found to be 5.92 ± 0.10 . up to 4th parity and then started declining.

Teat width

The teat width was found to be 2.41 ± 0.10 , 2.76 ± 0.13 , 4.11 ± 0.34 , 3.80 ± 0.13 and 3.60 ± 0.10 cm for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. The overall average teat width in the present study was found to be 3.37 ± 0.10 . The present study results revealed that the teat width was differed significantly ($P<0.01$) among different parities. The overall results indicated that the teat width was increased progressively till 3rd parity and then started declining onwards.

5.3 Production parameters

Test day milk yield

The test day milk yield of Purnathadi buffaloes was found to be 4.03 ± 0.33 , 5.06 ± 0.34 , 6.19 ± 0.42 , 6.22 ± 0.48 and 5.88 ± 0.45 kg for 1st, 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. It was found that the was increased significantly ($P<0.01$) upto 4th parity and then started declining from 5th and above.

Lactational milk yield

The lactational milk yield of Purnathadi buffaloes was found to be 1133.76 ± 49.96 , 1292.11 ± 38.95 , 1294.33 ± 30.74 and 1277.38 ± 35.41 kg for 2nd, 3rd, 4th and $\geq 5^{\text{th}}$ parity, respectively. The study revealed that the lactation yield of the buffaloes was increased as parity progressed. However, a significant ($P<0.05$) increase was observed upto 4th parity only. The average lactational milk yield in Purnathadi buffaloes was found to be 1252.09 ± 20.51 .

5.4 Relationship between the udder and teat morphology with milk yield in Purnathadi buffaloes.

Relationship between udder and teat morphology with Test day milk yield

The results of the correlations of udder morphology with Test day milk yield in Purnathadi buffaloes are presented in Table 4.10. The results of the

correlation revealed that the relationship of the udder length ($r=0.322$), udder width ($r=0.277$), udder depth($r=0.272$), Teat width ($r=0.276$) with TDMY was found to be positive and highly significant ($P<0.01$); however, there was positive but nonsignificant relationship was found between teat length ($r=0.119$) and TDMY. The positive relationship of all the udder and teat morphometric parameters with TDMY under the present study indicated that an increase in the TDMY is associated with an increase in the udder morphometric parameters.

Relationship between udder and teat morphology with Lactational milk yield

The results of the correlations of udder morphology with lactational milk yield in Purnathadi buffaloes are presented in Table 4.10. The results of the correlation revealed that the relationship of the udder length ($r=0.286$), udder width ($r=0.278$), udder depth ($r=0.276$), with LMY was found to be positive and significant ($P<0.05$); however, there was a positive but nonsignificant relationship found was between teat length ($r=0.042$) and Teat width ($r=0.194$) with LMY. The positive relationship of all the udder and teat morphometric parameters with LMY under the present study indicated that an increase in the LMY is associated with an increase in the udder morphometric parameters.

Conclusions:

The results of the study lead to the following conclusions.

1. The bowl-shaped udders and cylindrical teat shapes are most common in Purnathadi buffaloes.
2. The udder morphological parameters of Purnathadi buffaloes viz. udder length, width and depth increase progressively up to 4th parity and then decline.

3. The teat parameters such as teat length and teat width in Purnathadi buffaloes was increased progressively up to 4th and 3rd parity, respectively and then declined.
4. There is strong and positive relationship exists between test-day milk yield and lactational milk yield. The increase in test-day milk yield and lactational milk yield is closely associated with the udder morphometric parameters.
5. The relationship of teat length and teat width with the milk yield is weak, indicating teat length and teat width does not affect the milk yield in Purnathadi buffaloes.



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Vita

VII

VITA

The author Mr. Alane Prashant Sanjay was born on 9th March 1993 at Tembhurni Tq. Basmat Dist. Hingoli, Maharashtra State.

He passed his S.S.C. examination in first division in the year 2009 from Niwasi High School Barashiv Tq. Basmat Dist. Hingoli and H.S.S.C examination in the year 2011 from N. E. S. Science College, Nanded.

Further, he joined College of Veterinary and Animal Sciences Parbhani, in the year 2013 and successfully completed B.V.Sc. & A.H. degree course in first class in regular manner in year 2019 from Maharashtra Animal and Fishery Science University, Nagpur (M.S.). Then he joined post graduation and completed M.V.Sc. degree course in discipline of livestock production and management from Post Graduate Institute of Veterinary and Animal Sciences, Akola by achieving first class in year 2022.

He had participated in several Animal Health camps and N.S.S. (National Service Scheme) during his Graduation and several Cultural and Social activities during Post Graduate degree programme.



Thesis Abstract

THESIS ABSTRACT

- a) **Title of the thesis (in Capital letters)** : “**STUDY ON UDDER AND TEAT MORPHOLOGY AND ITS RELATIONSHIP WITH MILK YIELD IN PURNATHADI BUFFALO**”
- b) **Full name of student** : **ALANE PRASHANT SANJAY**
- c) **Name and address of Major advisor** : **Dr. D. M. Badukale**
Assistant Professor and Head,
Department of Livestock Production &
Management, PGIVAS, Akola
- d) **Degree to be awarded** : M.V.Sc.
- e) **Year of award of degree** : 2022
- f) **Major subject** : Livestock Production and Management
- g) **Total number of pages In the thesis** : 55
- h) **Number of words in the abstract** : 268
- i) **Signature of Student** :
- j) **Signature, Name and address of forwarding authority** :

(D. M. Badukale)

Head

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ABSTRACT

The present study was carried out to understand the udder and teat morphology and its relationship with milk yield in Purnathadi buffaloes. 90 Purnathadi buffaloes were selected randomly from its breeding tract. To study udder and teat morphology four udder based, three teat based and two milk yield based parameters were recorded. In udder, morphology the Bowl-shaped udder (54.44%) was more common. The udder biometric parameters viz. length, width and depth of udder was found increased significantly ($P < 0.01$) up

to 4th parity and then declined. In the teat morphology study, the majority (57.78%) of buffaloes possessed cylindrical shaped teats in the population under study. The overall teat length in the present study was found increased significantly ($P<0.01$) up to 4th parity, whereas the increase in teat width was significant ($P<0.01$) only upto 3rd parity. Among production parameters' TDMY was increased significantly ($P<0.01$) upto 4th parity, and the LMY was increased upto 4th parity. Correlation analysis revealed that the relationship of the udder length ($r=0.322$), udder width ($r=0.277$), udder depth ($r=0.272$), teat width ($r=0.276$) with TDMY was found positive and highly significant ($P<0.01$); however, between teat length ($r=0.119$) and TDMY it was positive but nonsignificant. The relationship of LMY with the udder length ($r=0.286$), udder width ($r=0.278$), udder depth ($r=0.276$) was found positive and significant ($P<0.05$); however, nonsignificant relationship was observed for teat length ($r=0.042$) and teat width ($r=0.194$) with LMY. Based on the results obtained, it can be concluded that the udder and teat morphological parameters increase with advancement in parity up to 4th parity, which is closely associated with the increase in milk production in Purnathadi buffaloes.

प्रबंध सारांश

प्रबंध सारांश

१. प्रबंधाचे शिर्षक : पूर्णाथडी म्हशींतील कास व सडाचे आकारविज्ञान आणि त्याचा त्यांच्या दूध उत्पादनाशी असलेला संबंधावर अभ्यास
२. विद्यार्थ्यांचे पूर्ण नांव : आळणे प्रशांत संजय
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६. मुख्य विषय : पशुउत्पादन आणि व्यवस्थापन
७. प्रबंधामधील एकूण पाने : ५५
८. प्रबंध सारांशामधील एकूण शब्द : २५३
९. विद्यार्थ्यांची सही :
१०. प्रबंधक कार्यवाहीस्तव :
पाठविणाऱ्या अधिकाऱ्याची
सही, नाव व पत्ता

(दि. म. बटुकले)

विभाग प्रमुख

पशुउत्पादन आणि व्यवस्थापन विभाग, स्नातकोत्तर
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सारांश

सदर अभ्यास पूर्णाथडी म्हशींमधील कास व सडाचे आकारविज्ञान आणि त्याचा त्यांच्या दूध उत्पादनाशी असलेला संबंधसमजून घेण्यासाठी करण्यात आला. या अभ्यासाकरिता पूर्णाथडी म्हशींच्या प्रजनन क्षेत्रातून १० पूर्णाथडी म्हशींची निवड

यादृच्छिकपणे करण्यात आली. या अभ्यासात कासेसंबंधित चार, सडासंबंधित तीन आणि दूध उत्पादनासंबंधित दोन मापदंड नोंदवले गेले. कासेसंबंधित मापदंडात, सदर अभ्यासातील म्हशींपैकी वाटीच्या आकाराची कास (54.44%) सर्वाधिक व सामान्यपणे आढळून आली. कासेचे मोजमाप जसे की, कासेची लांबी, रुंदी आणि खोली पहिल्या वेतापासून चौथ्या वेतापर्यंत पर्यंत लक्षणीयरीत्या ($P<0.01$) वाढलेली आढळली आणि त्यानंतर नंतर ती कमी झाल्याचे दिसून आले. सडाच्या आकारविज्ञान अभ्यासात, अभ्यासाधीन म्हशींच्या संख्येमधील बहुसंख्य (57.78%) म्हशींमध्ये दंडगोलाकार आकाराचे सड होते. तर सडाचे मोजमाप केले असता सडाची लांबी चौथ्या वेतापर्यंत लक्षणीयरीत्या ($P<0.01$) वाढलेली आढळली, तर सडाच्या रुंदीत झालेली वाढ केवळ तिसऱ्या वेतापर्यंत लक्षणीय ($P<0.01$) असल्याचे दिसून आले. उत्पादन मापदंडांमध्ये 'परीक्षणदिन दुध उत्पादन हे चौथ्या वेतापर्यंत लक्षणीयरीत्या ($P<0.01$) वाढत असलेले दिसून आले तर वेतातील दुधोत्पादन हे चौथ्या वेतापर्यंत लक्षणीयरीत्या ($P<0.05$) वाढत असल्याचे आढळले. परस्परसंबंध विश्लेषणातून असे दिसून आले की कासेची लांबी ($r=0.322$), कासेची रुंदी ($r=0.277$), कासेची खोली ($r=0.272$), सडाची रुंदी ($r=0.276$) ही परीक्षणदिन दुध उत्पादनाशी सह-सकारात्मक आणि अत्यंत लक्षणीय ($P<0.01$); तथापि, सडाची लांबी ($r=0.119$) आणि परीक्षणदिन दुध उत्पादनामधील सहसंबंध हे सकारात्मक परंतु लक्षणीय नव्हते. कासेची लांबी ($r=0.286$), कासेची रुंदी ($r=0.278$), कासेची खोली ($r=0.276$) यांचा वेतातील दुधोत्पादनाशी असलेला सहसंबंध हा सकारात्मक आणि लक्षणीय आढळला ($P<0.05$); तथापि, सडाची लांबी ($r=0.042$) आणि सडाची रुंदी ($r=0.194$) ही वेतातील दुधोत्पादनाशी सहसंबंध आढळला नाही. मिळालेल्या परिणामांच्या आधारे, असा निष्कर्ष काढला जाऊ शकतो की पूर्णाथडी म्हशींमधील कास व सडाचे आकारविज्ञान संबंधित मापदंड चौथ्या वेतापर्यंत प्रगतीसह वाढतात, जे त्यांच्या दूध उत्पादनाच्या वाढीशी जवळून संबंधित आहे.