Chapter I

INTRODUCTION
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The rapid growth of the world population in the last quarter of a century has made it necessary to increase the livestock production to a corresponding degree. This expansion has resulted in animals being subjected to greater extremes of climate. The relatively under-developed tropical and semi-tropical regions of the world offer the greatest scope for expanding livestock industry. Rising costs of labour and feeds have caused a greater reliance on pastoral production in the temperate regions. This has resulted in a lengthening of the period during which the stock are kept outside and thus subjected to increasingly cold weather. Further attempts to reduce labour costs have resulted in systems of management, where stock are kept outside or in uninsulated byres, throughout the winter.

Nutrition and milk composition

Feeding can greatly affect many milk constituents both quantitatively and qualitatively. Milk composition can be altered deliberately only if the effect of the individual components of the ration on milk is known. A good supply of energy for the dairy cow not only exerts a considerable influence on total milk production, but affects the protein content of milk and therefore its solids-not-fat content. In case the influence of a deficient or excessive supply of energy on the protein content of milk is being investigated, however, it is essential that only the energy fraction should vary, that of protein and all the other essential elements remaining constant in all
the groups. Many of the investigations that have been conducted do not comply with this ruling and in many instances, the duration of the experiment was too short. But, in the present investigation, this was taken care of by providing constant energy to the protein group and constant protein to the energy group.


Milk quality is determined by the proportion and properties of individual constituents together with the physical, organoleptic, hygienic and microbiological characteristics of the product and its value from the nutritional physiologist's point of view. The quality required from a milk sample, however, varies with the purpose for which it is to be used. This means that the assessment made varies with the conception of quality. Technologically, the principal characteristic of quality in milk for butter making are the content and composition of milk fat, whereas, for cheese industry, protein, fat and bacterial content are the main features. The quality of milk for drinking is determined principally by high digestibility, energy and protein contents
and by the biological value of the protein, although organoleptic characteristics also play their role.

The criteria applied when assessing the quality, therefore is dependent on the purpose for which the milk is to be used. The same is true for price assessment. Even to the present day, the very high esteem in which milk fat has been held has led to one single constituent of milk receiving particular emphasis. This somewhat unjustified and biased view point is altering however, as the interest of nutritional physiologists and dairy technologists in milk protein increases. In some cheese making regions of Europe, indeed protein content is already the basis of the milk price structure.

For all these reasons, the general concept of milk quality is less informative than exact data regarding quantity and composition of individual constituents. Figures for dry matter content or for the content of solids-not-fat are likewise of limited value in this connection, while values for energy content, which is a function of milk fat content, are of secondary importance when a differential assessment of milk quality is being made.

Climate

In extreme climates, nature places a premium on fitness and, by consistent pressure, develops strains or species fitted for survival under existing conditions. Variation of circumstances and demands in the natural habitat does not permit the forthright development of a new species, but the inevitable trend moulds and reshapes the animal until it either adapts to the local environment or perishes. This is a slow process. With increasing pressure for higher total
output and efficiency to meet demands from his animals, man is
giving increased attention to provide environments, even under
extreme conditions, which he thinks will permit animals to express
as near their genetic potential as possible and give maximum
economic return.

Animal productivity is affected directly and indirectly
by the climatic environment. Indirectly, the parameters of climate,
temperature, humidity, air movement, solar radiation, barometric
pressure and rainfall affect animal nutrition through the quality and
quantity of vegetation. A direct environmental consequence system
is the stimulation of the neuro-endocrine system resulting in
alterations of body functions.

Climatic stress affects milk yield and composition, blood
and urine characteristics, respiratory functions, skin capillary
resistance, metabolism, endocrine function, body fluids and electrolytes,
pharmacological sensitivity and permeability of tissues to bacteria.
These effects vary with the species, breed, the degree and duration of
climatic stress.

Animal productivity depends not only on the flow of
energy, food and water with the environment, but also on the
adaptability of organisms to the environment and in their interaction.
Adaptive physiological differences involve two concepts.

1. Resistance, which is related to tolerance of
environmental extremes by whole organisms,
tissues or enzymes and must be correlated with
the natural limits of the species and
2. Capacity, which permits normal activity in an altered environment and can best be evaluated by stress tests.

Physiological adaptability is the capacity and process of adjustment of the animal to itself, to other living material and to its external physical environment. Adaptation is such a complex phenomenon that it cannot be reduced to a single type of measurement or basic definition without gross over simplification. Adaptability may be evaluated by the animal's ability to adjust to average environmental conditions as well as to climatic extremes. Animals well adapted to a given environment are characterised by

1. Minimum loss of body weight during the exposure to stress such as nutritional deficiency, high milk yield and transport

2. High reproductive efficiency

3. High resistance to diseases and

4. Longevity and low mortality rate.

India, though essentially a tropical country, has different climates in different regions. Southernmost tip, being very near the equator, has totally different climatic conditions as compared to the northernmost border. Some regions in the north-east, south-east and south-west experience heavy rainfall, while some parts of central and western India are semi-arid having large sandy tracts. The geographic situation of this country lends it a peculiar character of possessing
several climatic zones or pockets.

Semi-arid and arid zones of North India form the home tract of many well known Zebu milch breeds like, Tharparkar, Sahiwal, Red Sindhi, Hariana and others. It has been the practice for sometime past to transport the members of these breeds to other parts of the country for boosting up the milk production in order to meet the demand of the local population. Such practice has, in most cases led to degeneration. Obviously, by the process of elimination, assuming the nutritional and breeding practices to be sound on the basis of recommended standards, one thing which strikes most is the question of adaptability of the animals to new environment. An answer to this question can be the outcome of a systematic study of animal performance and behaviour under different climatic conditions.

Milk secretion depends on the mammary gland receiving a continuous supply of various metabolites and hormones from the blood. The milk yield of all mammalian species undergoes seasonal variations. The season of calving affects milk yield, peak yield and lactation period. In cattle, the yield is relatively unaffected within the temperature range of 5°C to 21°C (Ragsdale et al. 1950 and 1951).

At temperatures lower than 5°C as well as from 21°C to 27°C, the yield decreases slowly whereas, above 27°C the decline is much more marked. The decline is also more marked in high humidities compared to low. It has been estimated that milk production decreases approximately 1 kg per each degree (C) rise in rectal temperature.
The optimal environmental temperature for lactation is dependent on the species, breed and degree of tolerance to heat or cold. There are also breed differences in the maximal and minimal critical temperatures, beyond which productivity decreases rapidly. For example, the milk yield declines in Holstein cattle at 21°C, in Brown Swiss and Jerseys at about 24°C to 27°C and in Brahmanas at 32°C. The minimal critical temperature for Jersey cattle is around 2°C, whereas Holsteins are not greatly affected even at -13°C (Johnson, 1965).

The Tharparkar breed came into prominence during the First World War, when some animals were taken to supply milk for the Near East Army camps. Here, their capacity for production under rigorous feeding and unfavourable conditions at once became apparent. Since then, many breeding herds have been assembled in India and Pakistan. In India and abroad, these cattle are known as Tharparkar since they come from the district of that name in the province of Sind (now in Pakistan). In its native tract and the areas neighbouring to it, the breed is called Thari, after the desert of Thar and it is also occasionally known as Catchi because the breed is also found on the borders of Cutch which adjoin Tharparkar to the south.

The district of Tharparkar in the south-west portion of Sind province (now in Pakistan) lies between 24° 13' and 26° 2' north latitude and 68° 40' and 71° 11' east latitude.

Fine performance of the Tharparkar cattle during the First World War in Mesopotamia encouraged the Government of India to experiment on these animals. A herd of Tharparkar cattle was established
at Karnal in the Punjab in 1923. Karnal is situated in an area which has mostly sandy loam soil. Summer temperatures are fairly high, reaching 116°F, but summers are usually dry. Average milk production based on 568 lactation from the year 1923 to 1934 at the Karnal farm is shown (Dastur and Kothavala, 1946) as 3791 lb.

The animals from the beginning were housed loosely in the buildings which were constructed somewhere in the year 1805 for British troops. These buildings were well insulated which tended to be cool in summer and warm in winter, and the animals were protected from the climatic hazards. From the end of the year 1966, the animals are being kept in the open paddocks (cart wheel type) of the new cattle yard.

The elevation of Karnal is 253 meters above mean sea level, latitude 29.7°, longitude 77° and is located 120 kilometers north (slightly north-west) of Delhi.

Study on the production potentialities and behaviour of physiological reactions of animals under extreme climate was one of the main aims. Problem of animal shelter was also thought to be answered on the basis of the findings of this investigation. No such data are available regarding the Tharparkar breed of milch animals. Therefore, the present investigation was carried out to answer the said questions. The detailed plan of the study and the various aspects investigated are discussed in the following chapters.