Factors Influencing Carcass Composition of Livestock

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Factors Influencing Carcass Composition of Livestock: a Review

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Abstract

Meat production depends on several environmental factors and management practices. Meat animal carcasses vary in composition through genetic, age and sex of animal, nutritional, and environmental effects. Carcass composition of various species differs considerably in terms of carcass weight, percentages of fat, muscle and bone. As animals become older and heavier the proportion of fat in their carcasses increases and the proportion of muscles and bones decreases. Uncastrated male animals produce carcasses with more muscle than do castrated males. At a particular fat level the value of a carcass is influenced by the muscle: bone ratio. A higher ratio is obviously better since it equates to more saleable lean meat as well as better carcass conformation. Beef breeds have a higher ratio than dairy breeds and entire males have a higher ratio than castrates. Several factors within control of livestock producers may be manipulated to achieve desirable effects in carcass.

Introduction

Meat production is based on the growth process of the animal which depends on several environmental factors and management practices. Meat animal carcasses vary in composition through genetic, age and sex of animal, nutritional, and environmental effects. Carcass composition of various species differs considerably in terms of carcass weight, percentages of fat, muscle and bone. As animals become older and heavier the proportion of fat in their carcasses increases and the proportion of muscles and bones decreases. Uncastrated male animals produce carcasses with more muscle than do castrated males. At a particular fat level the value of a carcass is influenced by the muscle: bone ratio. A higher ratio is obviously better since it equates to more saleable lean meat as well as better carcass conformation. Beef breeds have a higher ratio than dairy breeds and entire males have a higher ratio than castrates. The following discussion addresses several factors within control of livestock producers that may be manipulated to achieve desirable effects.

Genetic Factors

The growth and carcass composition traits differ between breeds within all farm animal species. As an animal matures, it undergoes an increase in the ratio of muscle to bone, followed by a decrease in muscle growth rate and an increase in the ratio of fat to muscle (Lawrie, 1998). However, different breeds differ in their rate of maturation and average mature weight. Therefore, standardizing measurements of body composition (proportions of muscle, fat and bone) to the same stage of maturity of body weight (ratio of actual weight to expected mature weight) results in much less variation in carcass composition than standardizing to the same age or weight. One exception to this rule is the Texel breed of sheep, which shows less total body fat than expected for its mature size.

In beef cattle, late-maturing breeds, such as the Continental European breeds, are often preferred under conditions of good nutrition, producing heavier carcasses with little fat. Early maturing beef breeds, such as the traditional British breeds (e.g.

Angus, Hereford, Shorthorn), can be slaughtered at lighter weights and may be preferred when food supply is limited or for certain markets (Kempster et al., 1986). Similarly, in lamb production systems, the use of early-maturing breeds (e.g. Southdown) will allow quick finishing of small lambs with good carcass composition. However, the use of larger breeds that mature later (e.g. Modern Suffolk strains) will result in heavier lambs with less fat. Traditionally, early-maturing pig breeds (e.g. Middle White) were used for pork production and later-maturing breeds (e.g. Large White) for bacon production. Strains and hybrids of improved pig breeds that are now used in pork and bacon production (e.g. Piétrain, Landrace, Hampshire, Large White) have better carcass composition compared to traditional British pig breeds (e.g. Tamworth, Gloucester Old Spot, Saddleback) owing to reduced fat levels and increased muscle percentage.

Breeds may partition fat and muscle differently between body depots. Dairy breeds of sheep and cattle have a higher proportion of body fat in internal depots than do meat breeds, which have higher proportions of subcutaneous fat. In general, more maternal sheep breeds, which have higher reproductive rates and higher levels of milk production, also have increased proportions of non-carcass fat. During growth and development, intermuscular fat is deposited before subcutaneous fat, which is deposited before intramuscular fat (Warriss, 2000). Therefore, relative to subcutaneous fat, large late-maturing cattle breeds have more intermuscular fat than small early maturing breeds, which have increased levels of intramuscular fat (e.g. British beef breeds compared to Continental European breeds). Breed comparisons in pigs have found that the Duroc, Meishan and Berkshire breeds have a high proportion of intramuscular fat compared to other improved breeds, and for some markets the level of intramuscular fat in pure Duroc pigs is too high for consumer acceptability. Breeds can also react differently to pre-slaughter, slaughter and processing methods. For example, leaner and lighter animals are more likely to suffer from cold-shortening in the carcass post mortem.

Genetic Parameters for Carcass Composition

Heritability is the proportion of the total phenotypic (observed) variation in a trait that is explained by genetic variation. It is therefore a measure of how much a trait is controlled by genes (or, more precisely, genes that act additively), as opposed to environmental influences. Heritability is expressed on a scale of 0 to 1, where a value of 1 suggests that the trait is completely controlled by an animal's genes, while management, feeding and other environmental factors play no part in determining the expression of the trait (Aberle et al.,

1989). Other things being equal, a higher rate of genetic improvement will result by selecting on a trait with high heritability. Relatively few studies have been conducted on genetic parameters of eating quality traits compared to carcass composition. However, in general, the heritability of most carcass composition traits is moderately high, and objective technological measures of meat quality are more heritable than sensory traits determined by sensory panel analysis.

Table 1: Heritability ranges for carcass composition traits across species

Sl. No.	Trait	Heritability*
1	Ultrasound muscle depth/area	Moderate–high
2	Ultrasound fat depth	Moderate–high
3	Carcass weight	Moderate–high
4	Carcass length	High
5	Dressing percentage	Low–moderate
6	Lean yield	Moderate–high
7	Lean : bone ratio	Moderate–high

* (Low = 0–0.25; moderate = 0.25–0.5; high = 0.5–1)

Physiological Age

All animals within species or breeds or among sexes do not grow, develop, fatten, or mature at the same chronological age. The term physiological age refers to the stage of development of the animal that can be described by identifiable stages of the body development or function, such as body height and weight, body composition, or onset of puberty. Body composition and body form (shape) change dramatically and continually during growth. Without change of form, the body would not function and could not maintain homeostasis. For instance, at birth the head weight is ~ 20% of live weight, while at slaughter it is only about 5%. The weights of the structural tissues increase relatively faster during growth than those organs, which do not support the body. A functional equilibrium will only be reached when tissues and organs have differential growth patterns. Growth intensities of the various carcass tissues also differ. In the beginning of the growing period, muscle tissue is laid down faster than fat, but the later-developing fat tissue exceeds rate of muscle growth at later stages.

Stage of maturity is an important factor in genotype-dependent variation in carcass composition. Early-maturing breeds, such as the wild pig and Meishan, have a lower mature body size and weight, which is reached earlier, compared with later maturing breeds (such as the white breeds). Differences in body composition are more pronounced when pigs of different mature weights are compared at the same weight, rather than at the same age. At the same weight, early-maturing breeds are at a somewhat advanced stage of development, or higher physiological age, compared to late-maturing breeds. As is known from beef cattle, late-maturing breeds have, in general, a higher growth potential and deposit fat later than early-maturing breeds or animals. Based on the lower mature size and the lower growth potential, and also the lower relative growth of subcutaneous fat at slaughter, the Piétrain type pig can be considered as an earlier-maturing breed than the white breeds. There is, however, no simple relationship between maturity characteristics and carcass composition: Meishan and Piétrain differ dramatically in carcass composition.

Often, it is not easy to assess the optimum weight at slaughter and it is dependent on the view

on 'slaughter maturity'. Value-based marketing from the farmer's point of view is market driven on the one hand to produce particular products, but is also related to costs, e.g. the increase in feed conversion ratio in proportion as growth proceeds. The value of a pig carcass is determined by its weight, fatness level and muscularity, although quality of the muscle mass should also be considered. There are differences between pig genotypes in these characteristics. The muscle-to-fat ratio is the most important factor in carcass composition and it varies a great deal among breeds and breed crosses. The lean meat percentage in fatter animals like the Meishan and other inland breeds is much lower than in the extremely muscular Piétrain type pigs. Also, the muscle-to-fat ratio differs according to gender. During the growth period young entire males will have a higher percentage of lean than fat. However, castrated males will, depending on feeding level, eventually reach a point that deposition of fat will exceed deposition of muscle. Gilts have an intermediate position.

Influence of Sex

Castrated males result in fatter carcasses. Short scrotum bulls and rams produce heavier carcasses with larger *Longissimus dorsi* muscle areas, less external and internal fat and higher score for conformation than steers and wethers. These effects are related to hormonal status of animals. Steers produce significantly more marbling and more tender meat than bulls. Bovine males have more intramuscular connective tissue than females. Male chicks had heavier carcasses compared to the female ones (Bogosavljevic-Boskovic, 2006). The differences exhibited in terms of the sex influence were statistically highly significant. Horn et al. (1998) stressed that the coefficient of live weight variation increased more in male chicks in the second part of the rearing period, compared to the females with the less pronounced increase. Grashorn and Clostermann (2002) calculated by regression analyses that the slow-growing hybrids needed 10–32 days more to reach the body weight of 2000 g, which the Ross hybrid had at 42 days of age. In this study the feed conversion ratio was

worse and the meat yield in the carcass and breasts was lower in the slow-growing hybrids than in the Ross hybrid. The meat had a darker colour, the ratio of abdominal fat and meat content in the drumstick were partially higher in the slow-growing hybrids than in the Ross hybrid.

Differences in terms of sex were recorded for almost all the traits. The carcass weight was significantly higher in the male chicks compared to the female ones, being the result of large differences in body weight. Entire males produce carcasses with more muscle than do castrated males. Sex has a major influence on fatness and conformation in cattle. Young bulls produce the leanest carcasses, followed by culled cows and steers, with heifers on average producing the fattest. Young bulls also produce carcasses with the best conformation, followed by steers and then heifers. Although they are very lean, cow carcasses have very poor conformation. Excluding these cow carcasses, fatness and conformation are inversely related in the other three sex classes.
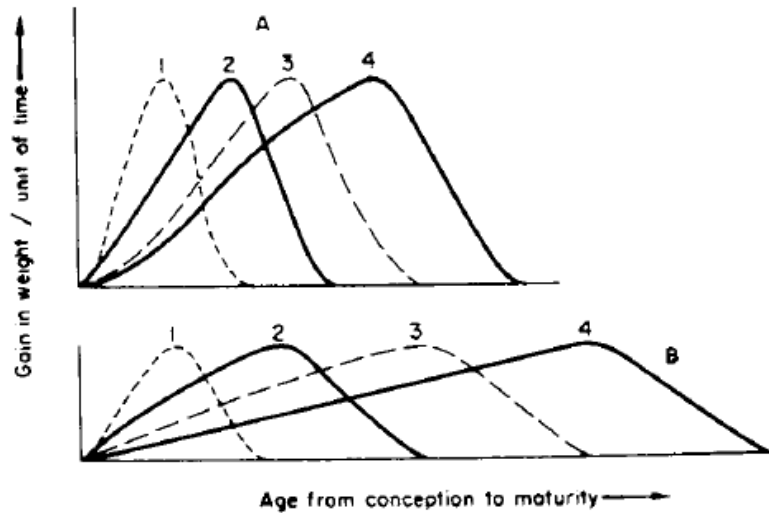
Nutrition

Although heredity dictates the maximum amount of growth and development that is possible, nutrition along with other environmental factors, governs the actual rate of growth and extent to which development is attained. Utilization of ingested nutrients is partitioned among various tissues and organs according to their metabolic rate and physiological importance. Maintenance and function of vital physiological system such as nervous, circulatory, digestive, and excretory systems, take precedence over muscle growth and fat deposition. The order of precedence is as follows: a) tissues that constitute vital organs and physiological process, b) bone, c) muscle, and d) fat deposition. During pregnancy, the developing foetus holds a priority similar to that of vital tissues and organ of dam.

Differences in the plane of nutrition at any age from the late foetal stage of maturity not only alter growth generally but also affect the different regions, the different tissues and the various organs differentially. Thus animals on different planes of nutrition, even if they are of the same breed and

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weight, will differ greatly in form and composition (*Hammond, 1932; McMeekan, 1940*). These workers showed that, when an animal is kept on a sub maintenance diet, the different tissues and body regions are utilized for the supply of energy and protein for life in the reverse order of their maturity. Under such conditions fat is first utilized, followed by muscle and then by bone; and these tissues are first depleted from those regions of the body which are latest to mature. The relationship between plane of nutrition and development of the different tissues of the body was shown by *Hammond (1932, 1944)*: the brain and the nervous system have priority over bone, muscle and fat in that order. In general, his findings have been confirmed by later investigators (Butterfield and Berg, 1966).

A, early maturity or high plane of nutrition, B, late maturity or low plane of nutrition.

Curves	1	2	3	4
	Head	Neck	Thorax	Loin
	Brain	Bone	Muscle	Femur
	Cannon	Tibia-fibular	Femur	Pelvis
	Kidney fat	Intermuscular fat	Subcutaneous fat	Intramuscular fat

(Courtesy:Pállson, 1955)

Fig.1: The effect of maturity and plane of nutrition on the rate of increase of different portions of the body (Pállson, 1955).

Figure 1 shows the order in which the different parts of the body develop on high and low planes of nutrition and in early and late maturing animals (Pállson, 1955). Authors have contended that carcass composition is weight-dependent and largely uninfluenced by age or nutritional regime. In an assessment of the different hypotheses, Lodge (1970) concluded that, while muscle weight appears to increase in proportion to total weight in a simple fashion, complexities arise from the degree of fat, and to a lesser extent that of bone, associated with the muscle. Although fast rates of growth caused by a high plane of nutrition can lead to an earlier onset of the fattening phase of growth, the nature of the diet, not surprisingly, is also an important growth-regulating factor. Thus, when the protein/energy ratio is increased, the fastest-growing animals may become leaner (Campbell and King, 1982). Indeed, when the ratio is very high the growth rate may be diminished (Campbell *et al*., 1984). Since males have a higher protein/energy requirement than females, this factor can cause differences between the sexes in the composition of the carcasses when the energy intake, at a given ratio, is altered (Campbell and King, 1982).

Clausen (1965) pointed out that the amino acid requirements for optimum growth of the carcass in pigs can differ from that required for optimum pork quality. It is generally accepted that lysine is the first limiting amino acid for the growing pig: when the level of intake of crude protein is below 14 per cent, however, other essential amino acids may become limiting (e.g. threonine) (Taylor *et al.*, 1973). In this species it may be more useful to formulate the requirements for individual essential amino acids than to provide crude protein (Swan and Cole, 1975).

The relationship of the ruminant to the quality of the diet is different since the intake into the tissues is substantially determined by the rumen microflora, the major source of nitrogen for microbial synthesis being the ammonia derived from the deamination of soluble protein entering the rumen and the activity of the microorganisms being determined by the amount of energy available to them. No incorporated ammonia is excreted and ingested protein may be wasted on high protein diets. On the other hand, non-protein nitrogen (e.g. urea) can be converted into protein when low protein diets are fed. Although the protein-synthesizing activity of the rumen micro-organisms diminishes the effect of differences between the incoming proteins in ruminants, there are differences in the rates at which they are degraded (Butler-Hogg and Cruickshank, 1989). Again, there may be differences in the nature of the proteins synthesized by the micro-organisms and this may require supplementation by amino acids in the feed (Storm and Orskov, 1984).

The efficiency of meat animals in converting feed into meat is generally related to the level of feed intake, but the relationship is rather complex. Highest efficiency in converting feed energy into body weight is achieved when animals are fed *ad libitum.* But, if feed energy intake exceeds the amount needed for lean tissue growth, the excess is used for fat deposition. Thus, animals full-fed high-concentrate diets usually produce more carcass fat, and consequently, are less efficient in converting feed to lean meat than are animals fed slightly below *ad libitum* energy intake, even though the *ad libitum* fed animals would be more efficient in total feed energy retention. This is particularly evident in the later growth stages, as muscles and bone approach their mature sizes. Slight to moderate feed restriction is an effective procedure to modify body or carcass composition. Abdominal fat in broilers can be reduced by a 3 to 5 day period of feed restriction, beginning at 5 to 7 days of age. Slight feed restriction of monogastric animals, particularly in the later growth stages, will produce leaner animals at slaughter, but limit feeding requires more labour and housing and animals reach acceptable slaughter weight more slowly. The additional cost associated with restricted feeding may surpass the additional value of leaner carcasses. Dietary energy of ruminant animals may be restricted conveniently by including variable amounts of fiber in the diet.

Frozen meat from semi- extensively reared male buffaloes undergo splitting of fiber and breaking or stretching of connective tissues causing significantly (P<0.05) improved tenderness and juiciness (Kandeepan, Biswas and Porteen, 2006). The meat from intensively reared young male buffaloes showed a significantly (P<0.05) higher moisture, collagen solubility, sarcomere length, myofibrillar fragmentation index, tenderness and connective tissue residue scores but lower collagen, insoluble collagen and shear force value compared to meat from semi- extensively reared spent male and female buffaloes (Kandeepan et al., 2009).

Protein

An adequate and continuous supply of protein is required in animal diets for growth and maintenance of tissues. Proteins are comprised of various amounts and kinds of amino acids, some of which can't be synthesized in animal body. These are called *essential amino acids*, and must be present in the diet of animal. Every animal has a daily need for dietary protein. Although animals can't synthesize tissue proteins beyond their genetic potential by consuming excess protein, the rate of accretion (growth) is readily reduced by an inadequate dietary protein. Growth rate in monogastric animals are reduced by an inadequate total amount of protein, a deficiency of any one of essential amino acids in the diet. In ruminants animals, amount and quality of dietary protein are less critical than in monogastric animals. If animals consume a surplus of protein, the excess is broken down and used as energy, or stored as fat.

Fat

Dietary fats are used by the animal for energy, and certain fatty acids are essential for growth. They also may be assimilated and deposited as body fat. Composition of deposited fat varies among species. All meat animals are able to synthesize fatty acids and/or adipose tissue from carbohydrates and proteins, and the fat which is deposited is characteristic of the species. Fats in the diet of monogastric animals may assimilate and deposited in relatively unchanged form; whereas, dietary fats consumed by ruminants undergo degradation and synthesis of more saturated fat by rumen bacteria before assimilation and deposition. Carcasses from monogastric animals fed a diet containing a specific type of fat will have fat deposits of similar chemical composition to the dietary fat. For example, pigs or chickens fed a diet high in unsaturated diet will have soft, oily carcass fat. However, the rapid turnover of depot fats permits the replacement of deposited fat by dietary changes.

Hormones

Hormones are substances secreted into body fluids by ductless endocrine glands or other tissues such as the intestinal tract. Hormones act as regulators of chemical reactions involved in the growth of tissues, and other physiological processes. Combinations of hormones are involved in growth process, and their interactive effects result in "normal" carcass composition is included in the following discussion. *Growth hormone* or *somatotropin* produces lean tissue growth throughout in animal. It is produced by anterior pituitary gland and promotes the release of class hormones from the liver and other tissues known as *somatomedins*. The somatomedins have insulin like activity and are responsible for protein synthesis associated with somatotropin. Such hormone-induced protein accretion partitions the utilizations of nutrients towards lean tissue growth and away from fat deposition.

The dramatic effects of somatotropin have been demonstrated in meat animals by the administration of synthetic somatotropin produced by genetically engineered microorganisms. Some experience suggests that carcass fat may be reduced by one-third or more by such treatments. Availability of plentiful supplies of growth hormone for administration to meat animals offers great promise for improvements in carcass leanness and meat production efficiency. Hormones of adrenal medulla, *epinephrine* or *norepinephrine,* exert widespread effect in the body. With reference to muscle tissue, these hormones assist in mobilization of glycogen to provide energy. However, their effects influence muscle protein and lipid metabolism as well. These effects may relate to the ability of epinephrine to activate certain tissue receptors known as β receptors. Hormone like substances have been developed that have chemical structures very much like epinephrine and norepinephrine. These materials are known as *β-adrenergic agonists* because they are effective in activating β-receptors. In addition, they are effective in repartitioning agents: they shift available nutrients away from fat deposition and towards muscle accretion. Animals receiving such repartitioning agents produce carcasses that have increased muscle size and decreased quantities of fat.

The hormones of testes and ovaries play an important role in growth and development of body. Differential rate of growth and development as well as tissue composition are associated with sex of animals. Males usually grow faster, mature later, and have carcasses that are more muscular and less fat than females. Meat animal producers frequently castrate male animals, a practice that modifies behaviour and sometimes improves meat quality, but causes deposition of more fat and less muscle during growth.

The principal hormones produced by the testes are androgens; those produced by the ovaries are *estrogens* and *progesterone.* Androgens stimulate growth in muscles by increasing protein synthesis, an action that is accompanied by decreased fat deposition. Certain muscles are more sensitive than others to effects of androgen, depending on their role in reproduction. In particular muscles of fore quarter of the male, especially those in neck and crest region, show greater development than in females or castrates. Androgens also stimulate deposition of bone salts causing increased bone growth as compared to females and castrates. However, when androgen levels become sufficiently high, they cause closure of epiphyseal

plates and consequent skeleton maturation precedes that of castrates.

Estrogens generally have little or no effect on skeletal muscle protein synthesis, but they are effective in promoting deposition of body fat. Specific effects depend on proximity to puberty and estrogen concentration. Females generally fattened at younger ages and lighter weights than males. With the exception of gilts, they are also fattening more quickly than male castrate. Gilts tend to fatten and mature later than barrows. Estrogen like androgen, stimulate bone salt deposition and even more effective in causing epiphyseal plate closure. Therefore female mature earlier than males.

Environment

Environmental conditions under which animals are reared may have marked influence on growth rate and even on body composition. The subject of heat regulation in farm animals has a wide economic significance. Sheep, cattle and pigs attempt to maintain their body temperature at a constant value which is optimum for biological activity. Of the three domestic species, sheep are most capable to achieve this, and pigs least capable (Findlay and Beakley, 1954) indeed, newborn pigs are particularly susceptible to succumbing to heat stress. Even so, adult pigs in a cold environment can maintain their skin temperatures at 9°C when exposed to air at –12 °C.

The environmental temperatures normally tolerated by living organisms lie in the range 0–40°C, but some animals habitually live below the freezing point or above 50°C. For short periods even more severe conditions are compatible with survival. In an environment of low temperature the development of many animals is prolonged (Pearse, 1939): under high temperatures it is frequently retarded in unadapted stock. A variable temperature has a greater stimulatory effect on metabolism than those which are uniformly low or high (Ogle and Mills, 1933). Prolonged exposure of an animal to heat or cold involves hormonal changes which are specific to these two stresses, whereas acute exposure of an animal to heat, cold, danger or other aspects of stress elicits a typical complex of reactions from the endocrine system, referred to as the general adaptation syndrome (Selye, 1950; Webster, 1974).

In general it would be expected that in a cold environment a large body would be advantageous since its relatively low surface to volume ratio would oppose heat loss; and that in a warm environment a high surface to volume ratio would help to dissipate heat. This generalization appears to apply to animals of similar conformation. Some of these principles can be seen to operate with domestic stock (Wright, 1954). Among cattle the yak, which inhabits regions of cold climate and rarefied atmosphere, possesses a heavy, compact body with short legs and neck: it is also covered with thick, long hair. Cattle of more temperate regions have a somewhat less compact frame; while tropical cattle have an angular frame, larger extremities, a large dewlap (i.e. the fold of skin hanging between the throat and brisket of certain cattle) and a coat of very short hair.

Bearing in mind that radiant energy is absorbed more by dark coloration and reflected more by light, it is not unexpected that many tropical cattle have a lightly coloured coat. Few authors have showed experimentally that cattle having a white, yellow or red coat, especially if the coat is of smooth, glossy texture, will absorb markedly less heat than those of a darker colour. Moreover, under given conditions of heat stress, the temperate breeds will have a higher body temperature than tropical breeds. The mechanisms for heat disposal (evaporation of water from respiratory passages, transudation of moisture through the skin and depression of metabolic rate) are less efficient and temperate stock tends to seek relief by behavioural mechanisms such as voluntary restriction of food intake, inactivity and seeking shade. This must necessarily restrict their development in relation to tropical breeds. There are many records to show that cattle with 'Zebu' blood produce a higher percentage of better-quality carcasses in hot, humid conditions (e.g. Queensland) than do animals of entirely temperate blood (Colditz and Kellaway, 1972). This tendency can be offset to some extent by providing pasture for night grazing.

Among sheep it is found that those in temperate areas are generally of moderate size, of compact conformation and with short legs and a thick wool coat. In tropical areas sheep have long bodies, legs,

ears and tails, and a coat of short hair rather than wool. In arid areas sheep frequently develop an enlarged tail, where fat is stored. The metabolism of the latter offsets the environmental scarcity of water and food. In general it is not the degree of heat alone which causes distress to animals in the tropics but its combination with humidity and the duration of these conditions. The suitability of livestock for introduction into new areas is not limited to physiological reactions: they must meet the economic and social needs of the population. Thus, for example, the excellent draught qualities of Indian cattle should not be sacrificed in an attempt to raise milk yields, and animals introduced into warm areas, because of their heat tolerance, should possess a potential for meat production (Wright, 1954).

Composition changes during pre-slaughter handling

Composition changes after animals are last removed from feed should be minimal with respect to levels of carcass fatness or meat/bone ratio provided this period is not excessively long. The main area of concern is whether there will be some loss of carcass weight as this will commonly represent a direct monetary loss. Most of the loss in live weight for the initial period following removal from feed is in the form of decreased gut-fill with no carcass weight loss. At what stage live-weight losses start to include some loss of carcass weight probably depends to some extent on how well the animals had been fed, and on the type of animals. But, on the basis of the results of one trial involving Angus and Angus-cross bulls and steers, at a final live weight of 550kg, an animal held off feed pre-slaughter for 6 hours would have yielded 6.9kg more carcass weight than another animal held off feed pre-slaughter for 30 hours.

Abnormal Growth Factors

Several non-pathological factors can cause abnormal or unusual growth and development of meat animals, such as double muscling, abnormal hyperplasia, hypertrophy and steatosis. Double muscling is the genetic condition of cattle causing them to have unusually thick, bulging muscles.

Animal exhibiting double muscling have a lower proportion of red fibers and higher proportion of white fibers as compared to normal animals. The white fibers are larger than red fibers which along with the increased proportion of white fibers, accounts for a hypertrophic condition of the muscle. When double-muscled cattle are compared to normal cattle, growth is more rapid, development of muscle is greater, and fat deposition is less. The muscle to bone ratio is greater, being on the order of 6:1.

Condition similar to double muscling exists in other meat species although of different genetic origin. Pig, sheep and turkey sometimes exhibit muscle development that is equal to extremes of double muscling. Steatosis is characterized by extensive fat infiltration into muscle fibers. Fat replaces the content of muscle fibers and the gross muscle appears to almost completely compose of fat. It is a non-inflammatory, non-pathological condition wherein no evidence is visible until the carcass is cut. The condition may be occur in beef, lamb, pork, etc,.

Conclusion

Carcass composition of food animals varies greatly due to certain factor as describe above. For the production of good quality meat we need to consider these factors seriously. Carcass composition of a particular animal depends from the time of conception to the slaughter, which includes methods of rearing parent stock, conditions during young growing period, selection of animal for slaughtering, period of transportation and stress during penning and slaughtering. In India, there is very limited research carried out on carcass composition and meat quality. So we need to study the effects of different factors in Indian conditions on carcass composition and meat quality of food animals. Achieving optimal animal well-being, carcass composition and meat quality will entirely depend on the scientific method of food animal rearing.

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