Cattle Adapt to Hot Environments by Altering Fat Storage Site

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BOTTOM LINE

Tropically adapted breeds that store fat confront the paradox of guarding against feed deprivation while avoiding body insulation by either stacking the fat in a crest on the neck or in internal deposits around the vital organs. Storage internally facilitates a readily available energy supply during drouth but also causes relatively expensive growth in the feedlot.

Summary

- Heat adapted breeds stored less of their fat under the skin, allowing for more potential for body heat convection than those adapted to colder climates.
- Heat adapted breeds that stored fat, stored more of their fat in the gut and around the body organs than those adapted to colder climates.
- Cold adapted breeds stored more of their fat intramuscularly (as marbling) than those adapted to hot climates.
- Breeds adapted to hot climates that had less Zebu influence (Tuli) stored more of their fat intramuscularly (as marbling) than those having more Zebu influence (Boran, Brahman).
- Zebu influenced steers (Brahman and Boran sired) stored more of their carcass fat in the crest than the other breeds.

Introduction

In order to guard against periods of forage deprivation, cattle must store fat. Those that must also guard against cold periods gain a double benefit from this fat, since it also insulates the body. This happy circumstance turns detrimental for cattle that must adapt to both periodic forage deprivation and periodic heat. These animals face the paradox of storing fat in a way to minimize its insulating effects. The purpose of this experiment was to discover how animals confront this paradox and to determine the implications on ability of cattle adapted to these climates to meet market requirements. These implications are germane since the market requires a certain level of fat in retail cuts while minimizing carcass fat trim.

Experimental Approach

Steers sired by Angus and Hereford (British), Brahman (Indian Zebu), Boran (African Zebu) and Tuli (African Sanga) bulls out of MARC III cows (a composite equally influenced by Angus, Hereford, Pinzgauer and Red Poll) were fed an 87% concentrate diet either ad lib or at maintenance levels for 140 d. They were then slaughtered and amount of fat was determined in the carcass and offal. Kidney, heart and pelvic fat and marbling in 12th rib were estimated by a USDA grader.

Results

The only cattle that expressed enough marbling to grade choice was the British-sired steers fed ad libitum. These steers had a marbling score 443 (400 = small). The Tuli, Brahman and Boran crossbred steers fed ad libitum had marbling scores of 369, 329 and 349 respectively. British-sired steers fed ad libitum had 18.9 lb of kidney, pelvic and heart fat, 85.8 lb of offal fat and 11.5 lb of carcass fat. All steers fed at maintenance had similar amounts of fat in each depot. Breeds only expressed differential storage in the depots when fed ad libitum. When allowed extra nutrients, British-sired steers put more fat intramuscularly and subcutaneously than other breeds. The Brahman and Tuli-sired steers used their extra nutrients to store fat around the kidney, pelvic and heart and in the offal (Table 1). The advantage in carcass fatness for ad libitum maintenance fed steers was greatest for those sired by British and Brahman bulls. Marbling score increased the greatest amount for the British, and the least for the Zebu- sired calves. When fed at ad libitum levels, the British-sired calves had more fat storage over the 12th rib, and less storage in the KPH and offal than the Tuli, Boran or Brahman-sired calves. The Boran-sired calves stored very little fat in any depot.

Conclusions and Implications

British breeds store fat in order to guard against both nutritional deprivation and cold stress. Tropically adapted breeds also store fat when nutrients are plentiful, but do so in a way to minimize body heat insulation. Some tropically adapted breeds (such as the Boran) have less ability to store fat (in any depot) when feed is abundant than other tropically adapted breeds (such as the Brahman and Tuli). Thus these breeds avoid the paradox of insulating the body with stored fat. Storage of fat internally (in highly vascular depots around the kidney, heart and pelvic cavity and in the viscera)) as a means of preventing body heat insulation may increase the availability of nutrients during feed deprivation but also may lower feed intake and feed efficiency when high quality feed is available (such as in the feedlot).

Table 1. Increase in fatness from maintenance to ad libitum.

Sire Breed	Marbling[b]	12th rib, in.	KPH, lb	Offal, lb	Carcass, lb
British	105	.48	12.3	41.4	52.8
Tuli	74	.28	13.9	45.1	34.5
Brahman	56	.39	15.0	44.9	55.0
Boran	35	.19	10.1	25.5	26.6

[a]Values are the advantage of fatness as measured in each depot to cattle fed ad lib as compared to those fed at maintenance (e.g., British-sired steers fed ad lib had .61 in. fat over 12th rib as compared to .13 in. for those fed at maintenance for an advantage of .48 in.).

[b] Marbling score=Traces[00]=200; Slight=300; Small=400.