BRAHMAN VERSUS ANGUS HEIFERS ON THREE PLANES OF NUTRITION 
V. EFFECT OF BREED, PLANE OF NUTRITION, AND SAMPLING TIME 
ON SERUM CHOLESTEROL AND TRIGLYCERIDE IN BRAHMAN 
AND ANGUS HEIFERS

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SUMMARY

The level of blood serum triglyceride was similar (P>.15) between 
Angus and Brahman heifers. The level of serum total cholesterol was higher 
(P<.02) in Brahman. Both serum lipids were affected by plane of nutrition. Total 
cholesterol and triglyceride were higher in heifers on a high plane 
of nutrition than those just above maintenance which had higher levels than 
those on a submaintenance plane. Season of sampling (month) was the most 
dominant factor influencing level of serum triglyceride (P<.001) and total 
cholesterol (P<.001). When the breed data were combined, triglyceride 
levels were lower and similar in August and January but were higher and 
similar in November and February. Total cholesterol levels were lower in 
August; however, unlike triglycerides, there was a linear increase through 
November to January before decreasing slightly in February.

INTRODUCTION

Although lipids constitute only a small portion of the diet of ruminants, 
metabolism of fat is of great importance in their nutrition, both because of 
vital roles played by specific lipids and because of extensive fat formation 
in the body as depot fat and milk fat. Lipids are transported in the form of 
lipoproteins for metabolism at various sites in the body; in addition, the 
composition of lipids is dependent on the extent of metabolism. Lipids in 
blood are classified into five major classes: cholesterol esters, phospho-
lipids triglycerides, free cholesterol, and free fatty acids.

Differences in lipid metabolism were found between Zebu and British 
breeds by Australian researchers who reported that, regardless of external 
factors, Zebus had higher serum levels of lipids than cattle of British 
breeds. Similar data were reported by the authors who evaluated three herds 
of crossbred Brahman x British cows on three pasture programs in Florida. 
The Australians also observed a significantly larger metabolic response to 
fasting (as measured by plasma free fatty acid elevation) in grazing Zebu 
cattle.

OBJECTIVE

This experiment was designed to measure changes in serum levels of 
total cholesterol and triglyceride in Brahman and Angus heifers fed on three 
planes of nutrition (less than maintenance, just above maintenance or much 
above maintenance).
PROCEDURE

Two serum lipids, total cholesterol and triglyceride, were monitored in 36 Brahman and Angus heifers, initially 17 to 23 months old, during a 190-day period of time. Heifers were stratified by breed, weight, age, sire, and initial serum total cholesterol, then were allotted to three groups of 12. Each group was kept for approximately 160 days on one of three planes of nutrition: (1) low - submaintenance, to lose .32 kg (.7 lb) per day; (2) medium - slightly above maintenance, to gain .20 kg (.44 lb) per day; and (3) high - much above maintenance, to gain .69 (1.5 lb) per day. Blood was collected four times: an initial sampling on August 17, shortly after removal from pasture, then on November 19, January 4, and February 28.

RESULTS AND DISCUSSION

Least-squares means for serum triglyceride and total cholesterol are presented in table 1 which is partitioned by breed. These data indicated that triglyceride levels were similar (P>.15) for both breeds, but that serum total cholesterol in Brahman heifers was higher (P<.02) than in Angus.

**TABLE 1. LEAST SQUARES MEANS FOR SERUM TRIGLYCERIDE AND TOTAL CHOLESTEROL FOR BRAHMAN AND ANGUS HEIFERS**

<table>
<thead>
<tr>
<th>Component</th>
<th>Brahman</th>
<th>Angus</th>
<th>RSD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triglyceride</td>
<td>22.9</td>
<td>20.3</td>
<td>8.53</td>
<td>&gt;.15</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>130.4</td>
<td>113.0</td>
<td>10.82</td>
<td>&lt;.02</td>
</tr>
</tbody>
</table>

\[N = 144\text{ total observations for both lipids, 72 for each breed.}\]

[b] Residual standard deviation.

When means for each plane of nutrition were evaluated (table 2), differences were detected for both triglyceride (<.07) and total cholesterol (P<.03). Serum levels of total cholesterol increased as the plane of nutrition improved, with the largest increase in cholesterol occurring as the intake level was elevated from the medium to high plane. Similarly, there was a tendency for serum triglyceride to be more concentrated with an increase in nutritional plane.

Plasma levels of total cholesterol phospholipid, and total lipid are expected to respond in a similar manner to changes in lipid metabolism; therefore, an assumption can be made that Brahman in this experiment also had larger serum concentrations of phospholipids and total lipids than Angus. In addition, one can expect that these differences in lipid levels between Angus and Brahman will be maintained since plasma lipids concentration is highly heritable.
TABLE 2. LEAST SQUARES MEANS FOR SERUM TRIGLYCERIDE AND TOTAL CHOLESTEROL IN HEIFERS ON THREE PLANES OF NUTRITION IN AUGUST, NOVEMBER, JANUARY, AND FEBRUARY\textsuperscript{a,b,c}

<table>
<thead>
<tr>
<th>Sampling time</th>
<th>Triglyceride</th>
<th>Total cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>August</td>
<td>17.7</td>
<td>13.4</td>
</tr>
<tr>
<td>November</td>
<td>21.7</td>
<td>31.0</td>
</tr>
<tr>
<td>January</td>
<td>10.5</td>
<td>15.6</td>
</tr>
<tr>
<td>February</td>
<td>20.3</td>
<td>31.1</td>
</tr>
</tbody>
</table>

\textsuperscript{a}N = 144 total observations for each lipid, 12 for each sampling time within plane of nutrition column.
\textsuperscript{b}Serum components units, mg/100ml.
\textsuperscript{c}Plane of nutrition x sampling time interactions: P<.0001, cholesterol; P<.003, triglyceride.

Seasonal effects (sampling times) were highly influential on both lipids (P<.0001). Triglycerides were cyclic, being approximately equal and lower in August and January and approximately equal and higher in November and February. In contrast, serum cholesterol rose linearly from a low in August to a high in January, then decreased slightly in February. The lowest level of both triglyceride and cholesterol was detected in August when ambient temperature was higher than 80°F, and when all heifers were grazing with no concentrate intake.

It was particularly interesting to observe combined breed means of both total cholesterol and triglycerides associated with an interaction between plane of nutrition and sampling time. Triglycerides were still cyclic over time in groups of heifers offered submaintenance and just above maintenance diets; however, mean levels were smaller for those on the submaintenance diets, indicating lowered serum triglyceride in low feed intake heifers. In addition, triglyceride levels in high feed intake heifers were relatively non-cyclic, raising from the August low to a range of 25.9 to 28.5 mg/100 ml during the last three collections. Total cholesterol increased in all three plane of nutrition groups, from lows in August to highs in January. From January to February there was a major decline in heifers on the submaintenance diet and minor declines in both groups fed above maintenance. It is evident that two different physiological influences were in effect. Those fed less than maintenance were mobilizing body tissue (adipose and muscle) for energy needs so there was a net loss of body tissue due primarily to mobilization of endogenous lipids. In contrast, heifers fed just above maintenance (in positive energy balance) did not have a net loss of body tissue.