COMPARATIVE STUDIES OF LIPID METABOLISM IN ZEBU AND BRITISH CATTLE IN A TROPICAL ENVIRONMENT

I. PLASMA LIPID LEVELS OF GRAZING CATTLE

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Summary

Plasma lipids have been studied in 77 British (Hereford and Shorthorn), 23 Brahman, 63 Brahman × British, 35 Africander, and 182 Africander × British grazing cattle. Cholesterol, phospholipid, and total lipid levels were significantly ($P < 0{\cdot}001$) higher in Zebu breeds than in British breeds. The proportion of cholesterol present in the free state was relatively constant and given by the regression equation:

$$F = 0{\cdot}1913T + 0{\cdot}6610,$$

where F = amount of cholesterol present in the free state and T is the total amount of cholesterol.

Cholesterol and phospholipid levels were significantly higher ($P < 0{\cdot}01$) in females than in males. Age was not a primary factor affecting the plasma lipid levels of adult cattle. Highly repeatable differences between animals within breeds were found in cholesterol and phospholipid levels. Estimates of heritability for cholesterol levels from dam–calf regressions were $34 \pm 11\%$ and $100 \pm 15\%$ at calf ages of 10 and 22 months respectively.

In heifers the triglyceride levels in Africander × British and British breeds were significantly higher ($P < 0{\cdot}01$) than in the Africander, Brahman, and Brahman × British breeds. Plasma protein-bound iodine was consistently positively associated with cholesterol levels.

Within breeds, animals with high plasma cholesterol carried significantly fewer mature cattle ticks (*Boophilus microplus*). The phospholipid–cholesterol balance for a given cholesterol level was different in males and females.

I. INTRODUCTION

In early investigations into the reactions of cattle to thermal stress physiological techniques were used, and suitability of animals for a tropical environment was assessed on the basis of physiological responses to stressful climatic conditions. Later work included biochemical methods and changes in blood constituents have been proposed as being due to adaptation to tropical climates.

It has been reported that in cattle heat stress causes a decrease in haemoglobin level (Mullick 1960), plasma proteins (Kamal, Johnson, and Ragsdale 1962), plasma CO_2-combining capacity and ascorbic acid and cholesterol levels (Blincoe and Brody 1951), thyroid activity (Johnson and Ragsdale 1960), and an increase in plasma creatinine levels (Blincoe and Brody 1951).

In general, Zebu and British breeds of cattle perform differently under tropical conditions, and hot summer climates cause the British breeds to perform below their

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inherent potential. In view of this and the effects of heat stress cited above, several workers have compared blood constituents of these two types of cattle (Kunkel *et al.* 1953; Kunkel, Stutts, and Shrode 1954; Erwin 1960; Evans 1963). There appear to be no comparative studies of the blood lipids in tropical and temperate breeds of cattle under natural environmental conditions such as those found in subtropical and tropical Australia. With this in mind a programme has been planned to study lipid metabolism in different breeds of cattle, and to relate the findings to biochemical mechanisms involved in adaptation to a tropical environment, and also the genetic basis of these mechanisms.

The first part of the programme, reported here, records the levels of plasma lipids of cattle grazing at the National Cattle Breeding Station, Belmont, Rockhampton, Qld. The results are interpreted relative to the age, sex, breed, and physiological status of animals and are also discussed in relation to previous published work on bovine blood lipids.

II. Materials and Methods

(*a*) *Animals*

Animals of each group sampled ran together and were maintained under natural field conditions at Belmont, as described by Kennedy and Turner (1959). The British animals were the progeny of matings of Shorthorn × Hereford (Shorthorn sire with Hereford dam) and Hereford × Shorthorn. The animals generally referred to as "Zebu" in the text were Brahman, Africander, Africander × British, and Brahman × British. The Zebu × British crosses included F_1, F_2, and F_3 generations.

(*b*) *Analytical Procedures*

Blood obtained by either jugular venipuncture or piercing the coccygeal artery was taken into heparin-treated bottles and centrifuged in a Christ refrigerated centrifuge for 30 min at 1300 *g* and 10°C to yield the plasma. Lipids were extracted from plasma and washed using the method of Folch, Lees, and Sloane-Stanley (1957). Blood lipid components were analysed as follows: non-esterified fatty acids by the method of Dole (1956), modified to produce a one-phase titration system (Tarrant, Thompson, and Wright 1962), and using an Agla micrometer for the titrations; total lipid by the procedure of Bragdon (1951) modified as a semi-micro method by Pande *et al.* (1963). Phospholipids were determined in either the Folch extract or the plasma by the method of Zilversmit and Davis (1950). A direct chemical method for estimating triglycerides was employed using the extraction procedure of Carlson (1963) combined with the hydrolysis procedure of van Handel and Zilversmit (1957), the resultant glycerol content being determined according to the method of Lambert and Neish (1950).

The range of cholesterol levels (20–200 mg/100 ml plasma) encountered in the initial part of this study suggested the desirability of comparing the precision and reproducibility of several methods using bovine blood. Total cholesterol was determined by the following methods:

(1) On the Folch extract using the iron reagent of MacIntyre and Ralston (1954).

(2) Direct analysis on the plasma using perchloric acid–phosphoric acid–ferric chloride reagent (Momose *et al.* 1963).

(3) Direct analysis on the plasma using a new Liebermann–Burchard reagent (Ness, Pastewka, and Peacock 1964).

Good agreement was obtained on 41 samples for total cholesterol estimation by all three methods, and the first method was selected for use in this laboratory. Free cholesterol was precipitated as the digitonide and measured as for total cholesterol.

In agreement with Riis (1964) it was found that cholesterol and phospholipid values from serum were essentially similar to those of heparinized plasma.

III. Results

The means and standard errors of the different blood lipid constituents for all animals studied are given in Tables 1–6. Since there are diurnal and seasonal variations in plasma lipid concentrations (O'Kelly, unpublished data) comparisons were made only between animals which had been exposed to the same environmental conditions and from which blood samples had been taken at the same time.

Table 1

Plasma lipid levels of F_3 grazing bulls

Samples taken in August 1965. Values are means ± standard errors, and are expressed as mg/100 ml plasma except non-esterified fatty acid values, which are expressed as μ-equiv/l plasma

	Breed			
	Pure-bred Brahman	Brahman × British	Africander × British	British
No. sampled	1	7	7	5
Age (months)	24	22	22	34
Total cholesterol (*T*)	196·4	138·1 ± 7·9	105·1 ± 6·7	94·8 ± 5·5
Free cholesterol (*F*)	44·6	27·4 ± 2·4	21·1 ± 1·7	19·9 ± 1·3
F/*T*(%)	22·7	19·6 ± 0·7	20·2 ± 1·1	20·9 ± 1·2
Phospholipid	190·6	161·1 ± 6·3	128·6 ± 6·7	112·0 ± 6·2
Triglyceride	23·2	17·9 ± 2·2	19·2 ± 1·0	17·7 ± 1·9
Non-esterified fatty acids	547	546 ± 101	454 ± 77	529 ± 62
Total lipids	533·0	411·0 ± 19·4	325·1 ± 19·4	292·0 ± 15·4

Table 2

Plasma lipid levels of 2-year-old heifers

Samples taken in January 1965. Values are means ± standard errors, and are expressed as mg/100 ml plasma except non-esterified fatty acid values, which are expressed as μ-equiv/l plasma

	Breed				
	Grade Brahman	Brahman × Hereford	Africander	Africander × British	British
No. sampled	3	3	2	3	3
Total cholesterol (*T*)	158·3 ± 1·5	141·9 ± 5·7	153·8 ± 3·0	149·1 ± 8·0	117·7 ± 8·0
Free cholesterol (*F*)	30·9 ± 1·0	29·5 ± 0·7	28·9 ± 0·3	31·4 ± 1·2	24·5 ± 1·5
F/*T*(%)	19·5 ± 0·5	20·7 ± 0·6	18·8 ± 0·2	21·1 ± 0·7	20·9 ± 0·2
Phospholipid	185·5 ± 1·3	167·1 ± 4·6	189·1 ± 3·4	183·4 ± 7·9	143·0 ± 3·4
Triglyceride	16·4 ± 0·6	15·8 ± 3·6	21·6 ± 1·8	31·2 ± 5·2	32·1 ± 0·1
Non-esterified fatty acids	889 ± 31	846 ± 21	724 ± 22	895 ± 55	821 ± 87
Total lipids	474·9 ± 3·0	427·8 ± 5·7	473·7 ± 4·4	471·7 ± 28·2	381·0 ± 22·2

(*a*) *Non-esterified Fatty Acids*

Non-esterified fatty acid levels (Tables 1 and 2) were within the ranges usually quoted for cattle, and no breed differences were observed.

(*b*) *Triglycerides*

No significant breed differences in triglyceride concentrations were observed in males, but in one group of heifers (Table 2) the levels in the Africander cross and British breeds were significantly higher ($P < 0{\cdot}01$) than in the Africander, Brahman, and Brahman cross breeds.

(*c*) *Cholesterol, Phospholipid, and Total Lipid*

(i) *Free and Total Cholesterol*

For any one animal species the proportion of plasma cholesterol present as cholesterol esters appears to be remarkably constant (Goodman 1965) and the value of the ratio of free : total cholesterol in cattle was reported as approximately 0·20 (Garton, Duncan, and Lough 1961; Hartmann and Lascelles 1965). The constancy of the proportion of plasma cholesterol present in the free state was observed in this study (Tables 1, 2, 5, and 6), with only minimal variations due to breed, sex, or age, and changes in total cholesterol concentrations due to season or differing physiological states were not accompanied by any significant alteration in the free : total cholesterol ratio. From data on 117 cattle of different breeds, age, and sex, the regression equation was found to be:

$$F = 0{\cdot}1913T + 0{\cdot}6610,$$

where F is the amount of cholesterol present in the free state, and T is the total amount of cholesterol.

TABLE 3

TOTAL CHOLESTEROL LEVELS IN SERUM OF F_3 WEANERS AGED 10 MONTHS

Values are means ± standard errors, and are expressed in mg/100 ml plasma. Number of animals sampled in each case are given in parenthesis

Breed	Serum Cholesterol Level	
	Males	Females
Brahman	82·7±9·7 (2)	60·4±5·2 (4)
Brahman × British	63·6±3·3 (27)	63·4±2·7 (18)
Africander	53·5±1·6 (8)	68·8±5·0 (5)
Africander × British	65·3±3·3 (60)	73·3±2·5 (37)
British	43·2±1·4 (30)	56·7±1·9 (26)

(ii) *Breed*

In animals of approximately the same age group, and running under the same environmental conditions, the plasma cholesterol, phospholipid, and total lipid concentrations of Zebu breeds were significantly higher ($P < 0{\cdot}001$) than those of British breeds for bulls (Table 1), heifers (Table 2), calves (Table 3), a group of 22-month-old males and females (Table 4), and in breeding cows when lactating (Table 5) and dry (Table 6).

(iii) *Age and Sex*

Cholesterol concentrations were higher at 22 months of age (Table 4) than at 10 months (Table 3). The cholesterol, phospholipid, and total lipid levels in mature animals varied widely, and no regular patterns due to age were observed between 40 and 157 months (Tables 5 and 6). It was concluded that age is not a primary factor affecting the plasma lipid levels of adult cattle in this environment.

Cholesterol levels were significantly higher ($P < 0{\cdot}01$) in heifers than in bulls among 10-month-old calves (Table 3). In the same animals at 22 months of age (Table 4), cholesterol and phospholipid concentrations were also significantly higher ($P < 0{\cdot}01$) in females than in males, but there was no significant difference between bulls and steers. Cholesterol, phospholipid, and total lipid levels of bulls sampled in August (Table 1) were lower than the values for heifers of the corresponding breed group sampled in January (Table 2). However, the magnitude of the differences in levels could not be assessed because of seasonal variations.

TABLE 4

PLASMA CHOLESTEROL AND PHOSPHOLIPID LEVELS OF 22-MONTH-OLD ANIMALS

Animals are the same as those used in Table 3. Values (expressed as mg/100 ml) are means ± standard errors

	Breed				
	Brahman	Africander	Brahman × British	Africander × British	British
Steers					
No. sampled			17	47	13
Cholesterol			110·0±4·5	115·1±2·4	85·0±4·4
Phospholipid			119·4±4·4	118·2±2·5	97·0±4·8
Bulls					
No. sampled		3	10	10	8
Cholesterol		117·5± 6·5	111·9±6·3	117·5±5·4	78·5±8·6
Phospholipid		117·4± 2·5	112·8±4·3	115·4±3·5	87·4±3·1
Heifers					
No. sampled	4	5	19	38	23
Cholesterol	135·8±14·6	136·6± 8·5	124·5±5·4	134·2±3·4	92·5±8·0
Phospholipid	147·4± 7·9	145·3±10·7	132·1±4·3	144·8±2·9	116·4±2·6

(iv) *Pregnancy and Lactation*

It seems well established that plasma concentrations of cholesterol esters, free cholesterol, phospholipids, and total lipids are greater in lactating than in non-lactating cows (Maynard, Harrison, and McCay 1931; Schaible 1932; Allen 1938; Duncan and Garton 1963; Kossila 1963; Storry and Rook 1964), and the results presented here are in conformity with these findings. Blood sampling in February (Table 5) showed that in both Brahman and Africander breeds the lipid levels were significantly higher ($P < 0{\cdot}01$) in the lactating than in the non-lactating animals. Six months later, in August, the animals of all breed groups studied (Table 6) were dry, and plasma lipid levels were significantly lower ($P < 0{\cdot}001$) than the February values. The differences between the subgroups (Table 5) within both the Brahman and

TABLE 5

PLASMA LIPID CONCENTRATIONS OF LACTATING AND NON-LACTATING COWS

Animals sampled in February 1966. Values (expressed in mg/100 ml) are means±standard errors

Breed	Age Range (months)	No. of Animals	State of Cows	Total Cholesterol (*T*)	Free Cholesterol (*F*)	*F*/*T*(%)	Phospholipid	Total Lipid
Brahman, group A	28—117	7	Lactating	252·4± 6·3	46·4±1·4	18·4±0·4	194·5± 7·5	620·9±15·6
Brahman, group B	28—117	6	Non-lactating	190·8±13·0	32·9±1·6	17·4±0·5	147·3±11·0	477·3±27·2
Africander, group A	27—151	5	Lactating	216·7±16·0	40·9±4·8	19·0±0·9	167·0±11·7	535·9±36·1
Africander, group B	27—151	15	Non-lactating	170·1± 7·1	29·5±1·2	17·4±0·4	137·4± 6·3	434·1±16·3
Brahman cross	40—52	8	Lactating	222·2±14·3	40·0±3·2	17·9±0·4	190·6± 4·7	569·5±25·5
Africander cross	40—112	28	Lactating	193·8± 7·0	35·8±1·2	18·7±0·4	164·1± 5·9	496·1±16·4
British	40—52	8	Lactating	139·9±12·0	25·0±1·2	18·7±1·5	143·5± 5·3	391·4±23·6

TABLE 6

PLASMA LIPID CONCENTRATIONS OF DRY ANIMALS

Animals are the same as those used in Table 5, sampled in August 1966. Values (expressed in mg/100 ml) are means±standard errors. Other details given in text

Breed	Age Range (months)	No. of Animals	Total Cholesterol (*T*)	Free Cholesterol (*F*)	*F*/*T*(%)	Phospholipid	Total Lipid
Brahman, group A	34—123	7	169·3±4·6	31·8±1·3	18·8±0·6	187·8± 7·6	482·1±12·6
Brahman, group B	34—123	6	136·0±6·5	27·3±1·8	20·0±0·6	158·1±12·6	397·7±28·1
Africander, group A	33—157	5	136·0±7·9	26·7±1·5	19·6±0·6	169·8± 4·1	411·1±15·3
Africander, group B	33—157	15	121·9±4·8	24·3±1·0	19·9±0·2	145·5± 4·6	363·9±10·8
Brahman cross	46—58	8	146·4±9·8	28·1±2·3	19·1±0·6	167·3±10·4	425·3±21·0
Africander cross	46—118	28	126·5±4·3	24·9±1·0	19·6±0·3	149·1± 4·0	377·1± 9·4
British	46—58	8	114·6±6·8	22·5±1·7	19·6±0·7	131·9± 6·3	229·0±16·5

Africander breeds also persisted in August (Table 6), and it is possible that part of the higher values of the A groups was a carry-over effect of lactation. Pregnancy, at approximately the 6-month stage, did not affect the level of plasma lipids.

(*d*) *Biochemical Individuality and Heritability*

The concept of biochemical individuality in cattle was tested using data from animals at different stages of growth and in different physiological states. The results, given in the following tabulation, show highly significant animal differences within breeds for both cholesterol and phospholipids:

Interaction		D.F.	Correlation Coefficient
Cholesterol levels at 10 months (Table 3) × cholesterol levels at 22 months (Table 4)	Heifers	79	0·784***
	Steers	67	0·491***
	Bulls	26	0·745***
Cholesterol levels in lactating cows × cholesterol levels in non-lactating cows (Tables 5 and 6)		70	0·812***
Phospholipid levels in lactating cows (Table 5) × phospholipid levels in non-lactating cows (Table 6)		69	0·404***

*** $P < 0·001$.

Heritabilities were estimated from dam–calf regressions, using cholesterol data for 111 dam–calf pairs representing three breed groups. The dams were sampled 2–3 months before the calves were born, and the calves were sampled at 10 and 22 months of age. Neither sex of calf nor breed group consistently affected the regressions which have therefore been combined for these classes. Age of calves at sampling had a considerable effect. The regressions of calf on dam were $0·168 \pm 0·055$ for data on 10-month-old calves and $0·502 \pm 0·076$ for 22-month-old calves. The latter gives a remarkably high heritability estimate of $100 \pm 15\%$. It is not easy to postulate a maternal effect which would inflate this estimate and any maternal effect should have had greater influence at 10 months than at 22 months.

(*e*) *Relationships with Other Characters*

Plasma cholesterol levels of 10-month-old calves (Table 3) were not significantly correlated with weight gain to that age. In a group of breeders (Table 5) neither total lipid nor total cholesterol levels of dam were significantly correlated with weight gain of calf to 9 months of age.

Plasma protein-bound iodine was consistently positively correlated with cholesterol concentration within breeds, as indicated in the following tabulation:

Animals	D.F.	Correlation Coefficient
10-month-old calves (Table 3)		
Females	77	+0·320**
Males	109	+0·446***
2-year-old cows	6	+0·486
9- to 20-month-old heifers	54	+0·443***

** $P < 0·01$. *** $P < 0·001$.

Within breeds, correlations between tick score (the number of cattle ticks, *Boophilus microplus* on one complete side of the animal) and plasma cholesterol concentration were negative and significant (Table 7).

TABLE 7

CORRELATIONS BETWEEN PLASMA CHOLESTEROL CONCENTRATIONS AND TICK SCORES WITHIN BREEDS

Plasma cholesterol concentrations taken from Tables 1, 3, 4, 5, and 6

Animals	D.F.	r
Females at 10 months	72	−0·425***
Females at 22 months	71	−0·484***
Males at 10 months	108	−0·204*
Steers at 22 months	64	−0·510***
Bulls at 22 months	21	−0·520*
Cows, lactating	42	−0·555***
Cows, non-lactating	42	−0·609***
Bulls (Table 1)	14	−0·558*

* $P < 0·05$. *** $P < 0·001$.

(*f*) *Relationship between Serum Cholesterol and Phospholipid*

The cholesterol–phospholipid relationships in 22-month-old animals were calculated (Table 8) and the results subjected to analyses of covariance. There were

TABLE 8

MATHEMATICAL RELATIONSHIPS BETWEEN SERUM CHOLESTEROL AND PHOSPHOLIPID LEVELS IN 22-MONTH-OLD ANIMALS

Means are given in Table 4

Breed	Correlation Coefficient	D.F.	Regression Equation†	S.E. of Regression Coefficient
Heifers				
Brahman cross	0·908***	17	$y = 0·7133x + 0·6271$	0·0798
Africander cross	0·848***	36	$y = 0·6671x + 0·7414$	0·0693
British	0·652***	21	$y = 0·4985x + 1·0855$	0·1264
Bulls				
Brahman cross	0·895***	8	$y = 0·6099x + 0·8034$	0·1077
Africander cross	0·928***	8	$y = 0·6380x + 0·7424$	0·0897
British	0·913***	6	$y = 0·9504x + 0·1407$	0·1741
Steers				
Brahman cross	0·830***	14	$y = 0·8000x + 0·4379$	0·1436
Africander cross	0·470**	42	$y = 0·4696x + 1·1022$	0·1361
British	0·921***	11	$y = 0·9102x + 0·2290$	0·1157

** $P < 0·01$. *** $P < 0·001$.

† y = log(phospholipid level); x = log(cholesterol level).

no significant differences in regression coefficients between breeds within sexes, although in the steers the regression coefficients for Africander cross and British

breeds were significantly different, but only at the 5% level. The adjusted means between breeds within sexes revealed no significant differences except in the females, which just reached the 5% level. Between sexes within breeds regression coefficients were not significantly different, but the adjusted means were significantly different at the 5% (Brahman cross) and 0·1% (Africander cross and British breeds) levels. In each breed the phospholipid level corresponding to a given cholesterol level was higher in females than in males.

IV. Discussion

(*a*) *Triglycerides*

The plasma triglyceride levels reported here for grazing animals are generally in the same range as the literature values (Evans, Patton, and McCarthy 1961; Duncan and Garton 1962; Storry and Rook 1964; Hartmann and Lascelles 1965) obtained on stall-fed animals and in which a different method of determination was used.

(*b*) *Breed Differences*

Garton in a review (1960) stated that breed does not much affect the blood lipid values of cattle. Masselin *et al.* (1962) reported that serum cholesterol levels of young bulls of English breeds exceeded those of the Hollando–Argentine breeds, and Storry and Rook (1964) found that cholesterol and phospholipids were present in higher concentrations in plasma of cows of the Channel Is. breeds than in Friesians. We found that breed does have a highly significant effect on plasma lipid levels; in a similar environment, the plasma cholesterol, phospholipid, and total lipid concentrations were always significantly higher ($P < 0{\cdot}001$) in the Zebu than in the British breeds.

(*c*) *Age and Sex*

The total cholesterol levels reported here (Table 3) for 10-month-old calves appeared to be low compared to the values obtained by other workers for calves on adequate diets (Shope 1928; Lennon and Mixner 1957; Shannon and Lascelles 1966). After the development of a fully functional rumen the plasma lipid levels appear to be independent of diet and presumably mainly influenced by normal growth processes and sex differences.

(*d*) *Lipids and Parasites*

While the effect of climate is important in the failure of British cattle to thrive in tropical conditions, parasitism also plays an important role. The cattle tick depresses animal performance, and resistance to it by Brahman cross and Africander cross cattle represents an important adaptation. The association between tick resistance and a high level of plasma cholesterol, seen between breeds and between sexes, is quite strongly confirmed in comparisons of animals within breeds (Table 7). This indicates some real functional relationship and, while the mechanism is as yet obscure, plasma cholesterol may prove a useful index of potential tick resistance.

(*e*) *Plasma Lipids and Biochemical Individuality*

Williams, Berry, and Beerstecher (1949) have suggested that the values of certain biochemical parameters are characteristic of the genotype and thus of use in breeding experiments. The levels of blood glutathione in young beef cattle (Kunkel, Stutts, and Shrode 1954) and plasma lipids in cows both in lactation and the dry period (Brungardt, Bray, and Hoekstra 1963; Kossila 1963) showed values characteristic of individual animals. The results of the investigations presented here [see Section III(*d*)] confirm that there are distinct animal differences in plasma cholesterol, phospholipid, and total lipid concentrations both within and between breeds which are maintained over a wide range of concentrations imposed by different physiological and environmental conditions.

Taylor *et al.* (1966) reported that estimates of heritability of cholesterol were generally small but indicated that many factors largely masked genetic influences. The results presented here indicate high heritabilities in both the Zebu and British breeds. Because of the breeding programme at Belmont it was possible to sample all the dams and calves under identical environmental conditions, thus eliminating much of the "non-genetic" variation; this may account in part for the high heritabilities found.

(*f*) *Thyroid and Lipid Levels*

The thyroid is an important regulator of metabolic processes and its level of activity, whether measured as thyroxine secretion rate or as level of protein-bound iodine in plasma, has been shown to be related to growth rates of cattle at Belmont (Post 1963, 1965). The thyroid hormone is implicated in some way in regulation of plasma cholesterol, and in humans plasma cholesterol is inversely related to thyroid activity in certain clinical conditions.

Kossila (1963) found that seasonal variation in protein-bound iodine and cholesterol levels in Ayrshire cows were parallel, and assumed that common factors influence them in the same direction. The results reported here show that this positive association is also found in comparisons of different animals run together and sampled at the same time. This contrasts with the inverse association recognized in human medicine.

(*g*) *Relationship between Serum Cholesterol and Phospholipid*

Peters and Man (1943) reported a constancy in the relationship between cholesterol and phospholipid in human serum which was unaffected by age or clinical condition. Popják (1946) extended this observation to include several animal species, although exceptions due to sex (Gertler and Oppenheimer 1954) and in cases of human atherosclerosis (Moore, Marmorston, and Kuzma 1963) have been reported.

In the cholesterol–phospholipid relationships for cattle presented here, the breeds did not differ in regression coefficients nor in the level of phospholipid associated with a given level of cholesterol. This indicates that the genetic factors which strongly affect these lipids act commonly on both components, and act similarly both between and within breeds. However, there is a deviation from a constant relationship in comparison of sexes; females were higher than males in plasma cholesterol, but even higher in phospholipid than would be expected from the general relationship.

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