Effect of Pregnancy and Lactation on Liver Vitamin A of Beef Cows Grazing Pangolagrass[1]

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Highlight

The effect of pregnancy and lactation on vitamin A and carotene in liver and plasma was determined for beef cows grazing pangolagrass. The cows averaged 13.4 years of age and had grazed pangolagrass continously as the only source of nutrients for an average of 9.5 years. Calves were weaned August 29, 1965, and cows were slaughtered December 8, 1965. Ten cows, nursing calves in 1965 and pregnant when slaughtered, had an average of 12.3 million I. U. equivalent vitamin A in liver and plasma; seven cows, dry in 1965 and pregnant, had 20.9 million I. U.; three cows, nursing calves in 1965 and open, had 13.3 million I. U.; and one cow, dry in 1965 and open, had 24 million I. U. vitamin A. A well managed pangolagrass pasture in southcentral Florida furnished adequate carotene to meet the vitamin A needs of producing beef cows.

Vitamin A is essential for normal nutrition of beef cattle. National Research Council (1970) (NRC) state that a 1213 pound dry pregnant cow required 19,500 I. U. and a 1102 pound nursing cow, 41,000 I. U. vitamin A daily. The average daily vitamin A intake would be 30,250 I. U. for a cow weaning a calf each year. A level of 40,000 I. U. daily would insure a reserve of vitamin A to meet stress factors when they occur. The object of this paper was to determine the level of vitamin A and carotene in liver and plasma of beef cows which had obtained all their nutrients by grazing pangolagrass (*Digitaria decumbens* Stent.) for an average of 9.5 years.

Procedure and production results of seven herds of grade Brahman cows in a cow-calf project in a 15-year grazing trial were presented by Kirk et al. (1970a). Levels of vitamin A and carotene in liver and plasma from grazing cows and fed steers were compared by Kirk et al. (1970b) but the importance of these two tissues as storage depots was not determined. Highest values found were 4310 micrograms (mcg) vitamin A per gram of dry liver and 1688 mcg carotene per 100 milliliter (ml) plasma. Low carotene values were zero per gram of liver and 9 mcg per 100 ml plasma. It was shown that 20 pounds good quality air-dried pangolagrass forage daily per cow furnished 1100 milligrams (mg) carotene, equivalent to 440,000 I. U. vitamin A. This is several times in excess of the level recommended by NRC (1970) for a producing beef cow. NRC (1970) state that 1 mcg vitamin A is equal to 3.3 I. U. and 1 mcg carotene to 0.4 I. U. vitamin A.

Carpenter et al. (1961) found that livers of calves averaged 1.35% of their live weight. These authors in a private communication suggested that liver percentage decreases as live weight increases, giving a value of 1.25% for cows. Shirley et al. (1963) showed that fresh liver had about 28% dry matter. Using these values, liver dry matter would represent 0.35% of the slaughter weight for cows. According to Duke (1935) blood volume for a bullock by the wash out method was 7.7% of body weight, or 3.85% for blood plasma.

Methods

Twenty-one cows with an average age of 13.4 years selected from the seven herds of the original phosphorus source trials were slaughtered on December 18, 1965. The pangolagrass grazed by the cows received 100 lb. N, and 50 lb. K_2O yearly, from 1955 to 1965. P_2O_5 at the equivalent rate of 25 lb./acre was applied each year from 1955 to 1958 with no phosphorus applied from 1959 to 1965. Four pastures permitted rotational and deferred grazing throughout the 11-year period.

The cows were classified into four groups according to their 1965 calving and pregnancy record and the data used for vitamin A study:

- Group 1. 10 cows weaned calves in 1965 and pregnant.
- Group 2. 7 cows dry in 1965 and pregnant.
- Group 3. 3 cows weaned calves in 1965 and open.
- Group 4. 1 cow dry in 1965 and open.

The cows except for short periods in late winter and early spring of 1958, 1960, and 1963 had adequate pangolagrass forage. Supplemental feed in these periods consisted of cottonseed hulls and citrus molasses, both devoid of vitamin A and carotene. Cows were given free access to common salt and modified salt sick mixture (Becker et al. 1953) but pasture forage was the only source of calcium and phosphorus.

Liver samples were obtained when cows were slaughtered. Samples were frozen until analyzed by the procedure of Gallup and Hoefer (1946) for vitamin A and A. O. A. C. (1960) method for carotene. Blood samples were citrated and iced until analyzed for vitamin A and carotene by the method of Kimble (1939).

Results and Discussion

There was adequate pangolagrass forage on the ground to carry the cows through the winter when they were removed in December 1965. Samples of grass collected 2 to 4 times each year averaged on an air-dried basis 5.22% crude protein and 0.27% phosphorus from 1955 to 1958, and 5.71% protein and 0.16% phosphorus from 1959 to 1965.

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Table 1. Vitamin A and carotene in liver and plasma of cows grazing pangola.

Item	Group 1	Group 2	Group 3	Group 4
No. cows	10	7	3	1
Age (years)	13.5	14	12	12
Grazing pangola (years)	8.9	10.4	10.2	7
Cows weaned calves in 1965	10	0	3	0
Cows pregnant on 12-8-65	10	7	0	0
Slaughter weight (lb.)	1181	1260	1168	1410
Carcass grade[1]	6	7	6	8
Dry liver weight (g)	1873	2000	1855	2236
Plasma volume (l)	20.6	22.0	20.4	24.6
Vitamin A:				
Dry liver (mcg/g)	1957	3130	2149	3218
Plasma (mcg/100 ml)	20	17	24	20
Total (mcg[2])	3.7$\overline{M}$[4]	6.3$\overline{M}$	4.0$\overline{M}$	7.2$\overline{M}$
Total I.U.	12.2$\overline{M}$	20.8$\overline{M}$	13.2$\overline{M}$	23.8$\overline{M}$
Carotene:				
Dry liver (mcg/g)	40	49	162	116
Plasma (mcg/100 ml)	960	1268	1006	1110
Total (mcg[3])	2.3$\overline{C}$[5]	3.7$\overline{C}$	3.1$\overline{C}$	5.3$\overline{C}$
I.U. vitamin A	0.9$\overline{C}$	1.5$\overline{C}$	1.2$\overline{C}$	2.1$\overline{C}$
Total I.U. vitamin A in liver and plasma	12.3$\overline{M}$	20.9$\overline{M}$	13.3$\overline{M}$	24.0$\overline{M}$

[1] Federal grades: 6, Low Comm.; 7, Comm.; 8, High Comm.
[2] 1 mcg vitamin A = 3.3 I.U.
[3] 1 mcg carotene = 0.4 I.U. vitamin A.
[4] $\overline{M}$ = 1 million.
[5] $\overline{C}$ = 100,000.

Cow data and vitamin A and carotene level in liver and blood plasma of mature cows are summarized in Table 1. The average slaughter weight for 21 cows was 1217 pounds, heavy for cows maintained on grass pasture in south-central Florida. Condition of cows is indicated by the U. S. Commercial carcass grade and a shrunk carcass of 53.7%. Slaughter weight was increased as 17 of the 21 cows were heavy with calf and dressing percentage decreased for the same reason.

The level of vitamin A per gram of dry liver ranged from an average of 1957 mcg for the 10 cows in Group 1 to 3218 for the one cow in Group 4. Plasma carotene ranged from 960 mcg per 100 ml plasma for Group 1 to 1268 mcg for Group 2.

Vitamin A levels in liver and plasma ranged from 12.2 million I.U. for Group 1 to 24.0 million for the single cow in Group 4. Storage of carotene in liver and plasma in equivalent vitamin A was 90,000 I.U. for Group 1 to 210,000 I.U. for Group 4. The average percentage of vitamin A in liver and plasma for the four groups was as follows:

Vitamin A, liver	99.1%
Vitamin A, plasma	0.1%
Vitamin A, liver carotene	0.2%
Vitamin A, plasma carotene	0.6%
Total	100.0%

The liver contained 99.3% and plasma 0.7% of the total vitamin A in these two tissues.

It is seen from Table 1 that the total I.U. vitamin A in liver and plasma in order of magnitude from low to high was: Group 1, 12.2 million; Group 3, 13.3 million; Group 2, 20.9 million; and Group 4, 24.0 million; the average for all groups was 15.7 million. These data indicate that giving birth and nursing a calf for approximately 7.5 months create a greater need for vitamin A than pregnancy and maintenance of a dry non-pregnant cow. The cows had an adequate reserve of vitamin A for (a) stress periods, (b) unnatural low level of carotene in forage, or (c) extremely poor utilization of forage carotene, to meet the vitamin A requirements for an extended period. Average vitamin A in liver alone for the 21 cows could furnish 42,466 I.U. daily per cow for one year if all the stored vitamin could be utilized and no other source of carotene was available. These data show that well-managed pangolagrass can meet adequately the vitamin A needs of beef cows with this forage as their only source of carotene.

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