Effect of Concentrated Feeding on Plasma Gastrin Levels and Abomasal Acid Secretion in an Adult Cow

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In the previous communications [8, 9], the effect of gastrin on abomasal acid secretion was concluded to become obscure with growing from suckling calf to adult cow. In an adult cow fed with roughage only, plasma immunoreactive gastrin (IRG) levels did not change significantly in spite of fixed time feeding. This study was designed to investigate the effect of concentrated feeding on IRG levels and abomasal acid secretion in an adult cow, since the post-prandial gastrin and acid secretory responses in monogastric animals vary with the composition of the meal [2, 4].

A Holstein adult cow with Heidenhain abomasal pouch (22 months old; B. W. 290 kg) used in the previous study were maintained with two different feeding conditions. In condition-1, and -2, 50% and 80% concentrate in TDN (=3.9 kg) were given respectively. The remainder of TDN were fed with Italian rye grass hay. Secretion from the pouch were collected every 30 min for 36 hours to determine its volume, pH, and titratable acidity. Blood samples for gastrin assay were also drawn every 30 min. These analysis were performed by the methods described as before [8, 9]. Gastrin has trophic effect on parietal cell of antral mucosa in men [7] and rats [6]. Hence biopsy specimens in two feed conditions were taken from the abomasal pouch through the canula for histopathological study and for the evaluation of the parietal cell numbers/mm².

Diurnal changes in plasma IRG levels and the fluctuation in the secretory volume, titratable acidity, and pH value of abomasal secretion under the two different feeding conditions are shown in Fig. 1. Under the condition-1, post-prandial elevation of IRG was not observed and the volume of acid secretion (14–32 ml/30 min) had no relationship to feeding, though plasma IRG levels (123–183 pg/ml) tended to be higher than that of the condition fed with roughage only as reported in previous study [9]. The titratable acid secretion (0–12.5 mM/l) were observed intermittently and did not paralleled to the fluctuation of plasma IRG.

Under the condition-2, large fluctuations in plasma IRG levels (130–228 pg/ml) appeared frequently. Post-prandial responses of plasma IRG were also clearly observed within 1 hour after feeding. Though the volume of secretion (21–40 ml/30 min) had no relationship to feeding, the titratable acid secretion levels (20.2–35.3 mM/l) were higher than that of condition-1, and rose to a peak value within 1 hour after feeding.

The significant correlation was observed between plasma IRG and total acidity (titratable acidity × volume) [n=75, r=0.591, p<0.01]. Equation for least square regression line was y=0.0033x+0.0276.

From these observations, the cow fed much concentrate appeared to have hypergastrinemia and abomasal acid hypersecretion. Acid hypersecretion observed in the condition-2 might be followed by hypergastrinemia, though the factors to stimulate gastrin and acid secretion were not manifested in cows. Therefore, VFAs [1], peptides and/or amino acids [3] contained in the ingesta should be elucidated to stimulate the gastrin release and lead to the acid hypersecretion. The numbers of parietal cell/mm² were 336±79.4 in the condition-1, and significantly increased to 878.4±127.3 in the condition-2 (p<0.001). Parietal cell numbers/mm² have been multiplied in the condition-2 (Fig. 2). Parietal cell multiplication has also been observed in long term administration of gastrin [6] and gastrin secreting tumor (Zollinger-Ellison syndrome) [7]. Therefore, it is suggested that the parietal cell multiplication observed in this study is
Fig. 1. Diurnal changes in plasma IRG levels (●—●), acidity (○—○), acid output volume/30 min (―), and pH (●—●) in an adult cow fed with 50% (upper) and 80% (lower) concentrate in TDN. The feeding periods are indicated by arrows.

Fig. 2. Parietal cell (arrows) distribution in the abomasal fundus of an adult cow fed with 50% (1) and 80% (2) concentrate in TDN. H.E. staining ×100.

Fig. 3. Mucosal lesion in the abomasal fundus of an adult cow fed with 80% concentrate in TDN. Ulceration extended into submucosa. H.E. staining ×40.
dependent on the hypergastrinemia due to the concentrate overloading.

Histopathologically, bleeding and ulceration extended into submucosa are noted in the biopsy specimens from a cow in the condition-2 (Fig. 3).

In the light of these facts, it is interesting to consider the pathogenesis of abomasal ulcer in feedlots cow.

REFERENCES


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成牛の血中ガストリンと酸分泌におよぼす濃厚飼料絶やの影響（短報）：安田和雄・小野恵一郎1・佐々木伸雄2・松尾俊春3・長谷川篤彦1・本好茂4・友田勇1（東京大学農学部附属家畜病院，1家畜内科学教室，2家畜外科学教室，3家畜病理学教室，4日本獣医学畜産大学内科学教室）Heidenhainの小腎を設けた成牛1頭を用い、TDNの50％（条件1）、80％（条件2）を濃厚飼料で給与した際の血中ガストリン値（IRG）と第4胃酸分泌（TTA）の変動を観察した。条件2のIRGは130～228pg/ml、TTAは20.2～35.3mM/lであり、条件1の123～183pg/ml、0～12.5mM/lと比較して高値を示した。また、小腎粘膜の組織学的検索により条件2では粘細胞数の増加、ならびに潰瘍の形成が観察された。