Some Physiological Aspects in Liduid-Fed Young Goats

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代用乳給与子ヤギの初期成育について

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INTRODUCTION

It is well know that suckling ruminants digest milk in the abomasum and lower digestive tracts, and their digestive process is almost similar to that of mono-gastric animals. Thus, glucose is considered to be a main energy source in the suckling ruminants. However, the energy source is gradually altered from glucose to VFA as the fore-stomach develops.

From results with kids in which fore-stomach was completely removed, and a low fiber concentrate diet was fed, HAMADA[1] suggested that long-term adaptation of ruminants to a single stomached digestive system may change hormonal and enzymatic activities affecting glucose metabolism. FUJIHARA[2] also reported that the growth rate of the goats fed a liquid diet for 12 months was almost the same as that of normal goats, and the glucose concentration of jugular blood in post-prandial condition was similar to that of mono-gastric animals.

In the present experiment, the changes of the concentrations in blood glucose and VFAs of the goats fed a whole milk and/or a commercial calf-milk were investigated during the three months after birth.

EXPERIMENTAL PROCEDURE

Twin female Japanese Saanen goats, 7-day-old and weighing 2.5 and 2.3 kg, were used. The goats were individually housed in wire cages during the entire experimental period of 3 months. The first month was designed as a whole milk feeding period, the second month as a whole milk and commercial calf-milk※※ feeding period, and the third month as commercial calf-milk feeding period. The chemical composition of the commercial calf-milk used was as same as that of previous report.[2] One-half a daily ration, which is 2-2.5% of the body weight based on the result of FUJIHARA,[2] was suspended in warm water and given to the goats from a open pail twice a day at 08 : 30 and 17 : 30. The animals were weighed once a week before the morning

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※※ Calf milk, NIHON-NOSAN Co. Ltd., Sakaide-shi, Kagawa.

feeding. Jugular blood was sampled before and after (2 and 4 hours) the morning feeding on the day of measuring the body weight. Blood glucose and VFAs were determined by the methods of SOMOGYI[3] and CONWAY and DOWNEY[4], respectively.

RESULTS and DISCUSSION

Feed consumption and growth curves of goats are shown in Figures 1 and 2. Compared with the standard growth of Japanese Saanen goats indicated by NAGASAWA[5], the growth of two goats during 2 months after birth was slightly greater, and thereafter it was almost comparable with the standard growth of female goats on general feeding. The growth curves indicated in Figure 1 was very comparable with that of FUJIHARA[2] using kids fed a liquid diet. As shown in Figure 2, the feed intakes of goats increased up to 3 months of age, and this is paralleled with the increase of body weight in both goats. FUJIHARA[2] reported previously that the feed intake of goats fed a liquid diet

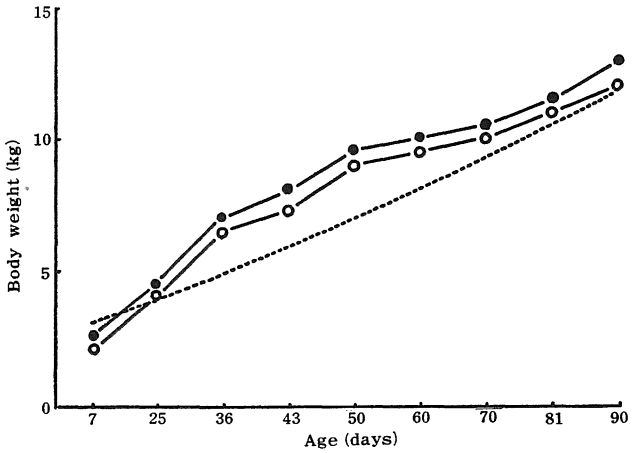

Fig. 1. Growth Curves of goats. (Solid circle : Goat A, liquid circlo : Goat B, dotted line : Standard growth by, NAGASAWA[5])

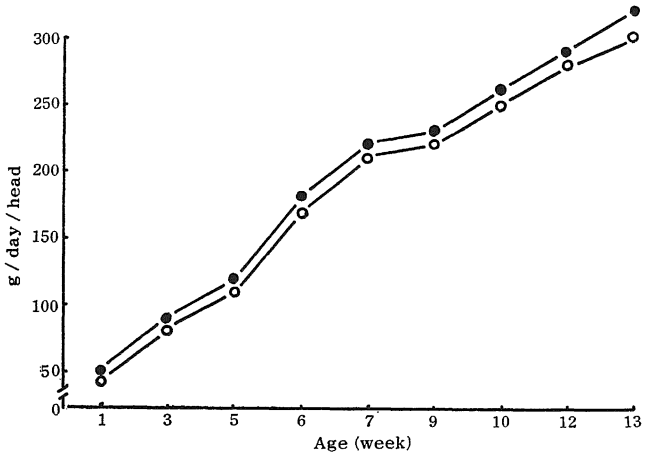

Fig. 2. Changes in feed consumption of goats.
(Solid circle : Goat A, liquid circle : Goat B)

Table 1. Daily gain (g)

Age	1-month-old	2-month-old	3-month-old
Goat A	151.5±40.5*	135.7± 67.2	90.0±29.4
Goat B	138.0±16.0	136.0±106.5	83.3±23.6

* Averaged value ± standard deviation.

was constant or even decreased after 6 months of age, and suggested that there were some factors restricting feed intake in the liquid feeding of ruminant. In the present experiment, however, the feed intake increased constantly with the increase of body weight, and there were no depression in appetite of goats during 3 months of age. ORSKOV[6] reported with young sheep trained to suck a liquid diet from a bottle that the utilization of supplemented various proteins was more effective in liquid feeding than in solid feeding. From these results, it may be suggested that liquid feeding is more effective than the solid feeding on the growth of young ruminants.

The daily gain (g/day) is shown in Table 1. The daily gain was largest in the first month in both goats, and gradually decreased. The decrease of daily gain in the second and third months may be affected by the change of feed being eaten (whole milk to commercial calf-milk). This shows that whole milk was the best feed for young animals. Adaptation may be expected in long-term feeding of the liquid diet. The adaptation mechanism was described previously by HAMADA[1] and FUJIHARA.[2]

The concentrations of blood glucose and VFAs are given in Table 2. It is well known that the blood glucose concentration in young is higher than that of adult ruminants, and the concentration falls slowly down to that of adult ruminants during 2-3 months after birth. According to TAKESHITA and SASAKI,[7] the blood glucose level in new born calves was 105-112 mg/100 ml at 20-30 hours after birth. YOUNG et al.[8] reported that the post-absorptive blood glucose concnetration in calves fed milk for 105 days was 50-60 mg/100 ml, and LUPIEN et al.[9] reported a blood glucose concentration of 85 mg/100 ml in 30-week-old gastrectomized and fasted calves. In the present experiment, the blood glucose concentration in post-absorptive and post-prandial conditions was 54-55 and 97-98 mg/100 ml at 3-month-old, respectively, and these figures

Table 2. Concentrations of blood glucose and of blood VFA indicated as mg/100 ml.

Age	1-month-old			2-month-old			3-month-old		
Time after fed	0	2	4	0	2	4	0	2	4
Blood glucose									
Goat A	82.0	83.0	83.6	85.8	95.5	85.6	55.5	98.5	60.0
Goat B	79.2	72.3	89.5	83.6	94.5	87.0	54.0	97.0	64.5
Blood VFA									
Goat A	0.72	0.60	0.65	0.90	—	1.05	1.21	1.02	1.14
Goat B	0.69	0.60	0.65	1.08	—	1.35	1.08	1.08	1.02

were almost comparable to the results of YOUNG et al.[8], LUPIEN et al.[9] and FUJIHARA,[2] and also very similar to those of mono-gastric animals. HAMADA[1] reported, however, that post-prandial serum glucose was 119 mg/100 ml in kids whose fore-stomach was completely removed. From the results mentioned above, it is suggested that the physiological condition of glucose metabolism in young stage should be continued by long-term liquid feeding until the ruminant becomes adult. On the other hand, the concentration of blood glucose in post-absorptive and post-prandial conditions was 82-85 and 72-95 mg/100 ml, respectively, during 1- to 2-month-old. These figures show that the response of the feeding on the level of blood glucose was not so large, and were almost comparable with the result of TAKESHITA and SAKAI[7] using new born calves at 50 hours after birth (88.8±20.5 mg/100 ml). These conditions might show that glucose is a main energy sourcc in the suckling ruminant. Although the physiological mechanism was not clarified in this experiment, the change of the feed being eaten may be considered to be a factor in the changes of the blood glucose concentration.

As shown in Table 2, the blood VFAs concentration was 0.6 1.3 mg/100 ml, being less than one-half or -third the value observed in adult goats (2.2-2.3 mg/100 ml).[10] In the 3-month-old goats, blood VFAs concentration was 1.0-1.2 mg/100 ml, and these figures were same as that of FUJIHARA[2] using goats fed a liquid diet for 12 months. Although the concentration of blood VFAs was slightly higher in 2- and 3-month-old than that in 1 month-old, from the results mentioned above it can be suggested that the microbial fermentation in the rumen is very limited when the goats were fed a liquid diet, and the glucose is considered to be a main energy source, and that, at least, in young ruminant the physiological mechanism might be similar to that of mono-gastric animals in glucose utilization.

SUMMARY

Twin goats were fed a liquid diet (whole milk and/or commercial calf-milk) for three months after birth, and the following results were obtained.

1. The goats possibly grow at almost the same rate as the normal goats maintained by a ordinary feeding technique.
2. The concentration of post-prandial (2 hours after feeding) blood glucose was 72-98 mg/100 ml, and this value is almost the same as that of mono-gastric animals.
3. The blood VFAs concentration in post-prandial condition was very low, and this suggests that the ruminal fermentation is scant in the liquid fed goats.

ACKNOWLEDGEMENTS

The author expresses his appreciation to Prof. I. TASAKI, Nagoya University, for his valuable suggestions. A part of this work was done at Experimental Farm of Kagawa University. The author gratefully acknowledges Mr. K. OHMATSU and Mr. H. SHIRAI for their careful management of the experimental animals.

REFERENCES

1. HAMADA, T. : J. Dairy Sci. **56** : 474−483, 1973.
2. FUJIHARA, T. : Jap. J. Zootech. Sci. **46** : 283−289, 1975.
3. SOMOGYI, M. : J. Biol. Chem. **195** : 19−23, 1952.
4. CONWAY, E. J. and DOWNEY, M. : Biochem. J. **47** : IV, 1950.
5. NAGASAWA, H. : Chikusan Daijiten (K. SASAKI ed.) Yokendo Co. Tokyo 1964. P. 939−940. (in Japanese)
6. ORSKOV, E. R., FRASER, C. and ELIZABETH, L. CORSE : Br. J. Nutr. **24** : 803−809, 1970.
7. TAKESHITA, K. and Y. SASAKI : Jap. J. Zootech. Sci. **40** : 255−258, 1969.
8. YOUNG, J. W., OTCHERE, E. O., TRENKLE, A. and JACOBSON, N. L. : J. Nutr. **100** : 1267−1273, 1970.
9. LUPIEN, P. J., SAUER, F. and HATINA, G. V. : J. Dairy Sci. **45** : 210−217, 1962.
10. SHIBATA, F. : Mem. Lab. Anim. Nutr. Nagoya Univ. **3** : 7−8, 1963.

摘　　要

著者は先に長期間（12ケ月）代用乳のみを給与した場合のヤギの消化管の発達とその生理的機能等について報告したが，本試験では特に代用乳による育成子ヤギの初期の成長速度とそれに関連した体内の生理的変化の様相を明らかにする目的で行われた．生後7日令の子ヤギ2頭（双子）を供試し，雄鶏用ケージ内で飼育したが，最初の1ケ月間は全乳（牛乳）を，2ケ月目は全乳と代用乳を等量ずつ，3ケ月目は代用乳のみを給与した．その結果，次のことが明らかになった．1：実験の全期間を通じて2頭のヤギとも食欲の減退はみられず，その成長は通常飼育のものと比べてやや速いようであった．2：食後2時間目の血中のグルコース濃度は全乳給与期より代用乳給与期で高くなる傾向にあったが全期間を通じて72.0～98.5mg/100ml であり，この値は単胃動物のそれと類似していた．3：血中の VFAs 濃度は成育が進むにつれて高くなる傾向にあったが，全期間を通じて1.35mg/100ml と非常に低い値であった．このことは前報の結果とも等しく第一胃内醗酵がほとんど行われていないことを示唆するものである．