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# PLASMA CONSTITUENTS IN THE SOW*

## MINERALS, GLUCOSE, UREA-N, PROTEIN AND TRANSAMINASES IN RELATION TO WEANING

By

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BENJAMINSEN, EDVARD and INGER W. DISHINGTON: *Plasma constituents in the sow. Minerals, glucose, urea-N, protein and transaminases in relation to weaning.* Acta vet. scand. 1981, *22*, 382—390. — The concentrations in plasma of total protein, urea-N, Ca, Mg, Na and K and the activity of aspartate aminotransferase (ASAT) and alanine aminotransferase (ALAT) in plasma were studied in 20 sows from one week before weaning until four weeks after weaning. Ten of the sows resumed ovarian activity within 10 days after weaning, while in the other 10 sows the resumption of ovarian activity was delayed. Plasma glucose was studied in 10 sows from one week before weaning until two weeks after weaning, five of these sows had delayed resumption of ovarian function. After weaning the concentration of total protein and the ALAT activity increased, while plasma glucose and Mg decreased. Concerning ASAT, Ca, Na and K no changes were observed. A transient increase in urea-N level took place after weaning in sows with prolonged weaning-to-ovulation period. In sows with normal weaning-to-ovulation period no change in urea-N was observed. This was the only difference in blood chemistry observed between sows with normal weaning-to-ovulation period and sows with prolonged weaning-to-ovulation period.

blood constituents; sow; lactation; post weaning; reproduction.

The use of multiple blood analyses to assess the metabolic and nutritional status in the dairy cow has attracted much attention and seems to be of value in modern preventive medicine (*Payne et al.* 1970, *Garden & MacDonald* 1975). In the sow similar recordings of blood profiles have received little attention.

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In connection with weaning in the sow, several environmental and physiological conditions change. Milk production ceases and feed consumption is often reduced. From being in a negative energy balance, the sows usually return to a positive energy balance. In addition housing conditions often change at weaning from pens to narrow stalls. It is not unlikely that shifts in blood constituents take place concomitant with the external and internal changes mentioned.

In dairy cows, connections between various blood constituents and fertility have been reported (*Hewett* 1974, *Downie & Gelman* 1976, *Rowlands et al.* 1980). Similar studies relating blood components to reproduction in the post weaning sow, appear not to have been conducted.

The present work was undertaken in order to study plasma constituents in the sow during the post weaning period. It was of special interest to relate blood profiles to the ability to resume ovarian activity after weaning.

## MATERIALS AND METHODS

Among 92 sows regularly blood sampled after weaning (*Benjaminsen & Karlberg* 1979), 20 sows were retrospectively chosen for blood chemistry studies. Ten sows had resumed ovarian activity within 10 days after weaning while in the other 10 sows resumption of the ovarian activity was delayed (mean 30—40 days, range 19 to 55 days) as confirmed by progesterone determinations (*Benjaminsen & Karlberg* 1981). Blood samples had been taken weekly and the period studied was from one week before weaning until four weeks after weaning. The samples were centrifuged and the plasma stored at —20°C until analyzed. The sows were of the Norwegian landrace breed. The lactation period was six weeks. During lactation the sows were kept in pens, but were moved to single stalls at weaning.

The feeding used was a standardized, well composed pelleted concentrate mixture (digestable crude prot.: 17.2 %, metabolizable energy: 11.7 MJ/kg). Ad libitum feed consumption was allowed during lactation (6—7 kg/day). At weaning the food ration was reduced to about 1.5—2 times maintenance level (3—4 kg/day). Thin sows received somewhat more concentrate after weaning than sows in good body condition.

The plasma activity of aspartate aminotransferase (ASAT/

GOT) and alanine aminotransferase (ALAT/GPT) were measured at 37°C as described by *Keiding et al.* (1974). Total plasma protein was measured by the biuret method (*Weichselbaum* 1946). Urea-N concentration (mmol N/l) in plasma was measured using a full-enzymatic method described by *Talke & Schubert* (1965). For all the analyses mentioned above a Gemsaec fast analyzer was used. Plasma glucose was measured with the Technicon Autoanalyzer ferricyanide reduction method, as described by *Blom & Halse* (1975). The plasma concentrations of calcium, magnesium, sodium and potassium were determined using atomic absorption (Perkin - Elmer 303).

In the present study the blood samples were taken shortly after feeding, between 9 and 11 a.m. To study if a possible circadian fluctuation in plasma glucose concentration exists, two post weaning sows were blood sampled every second hour for 24 h.

## RESULTS

Plasma glucose levels in two sows during a 24 h period are shown in Fig. 1.

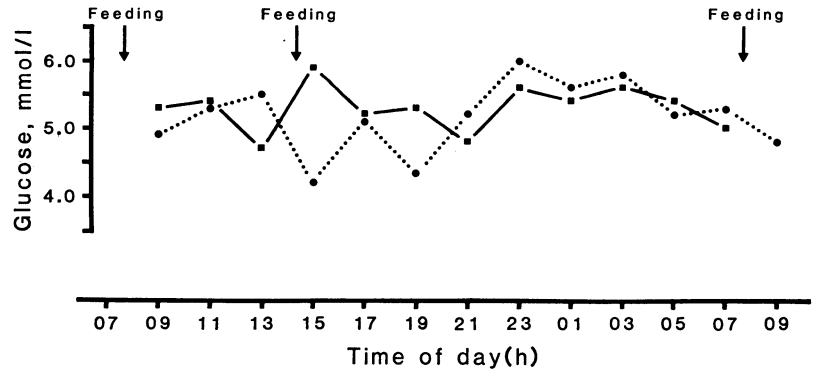


Figure 1. Circadian variation in plasma glucose in 2 post weaning sows.

During the post weaning period studied significant changes in the activity of ALAT and in the concentrations of total protein, urea-N, glucose and magnesium in plasma were found (Fig. 2). For ASAT, calcium, sodium and potassium no change was found after weaning (Table 1).

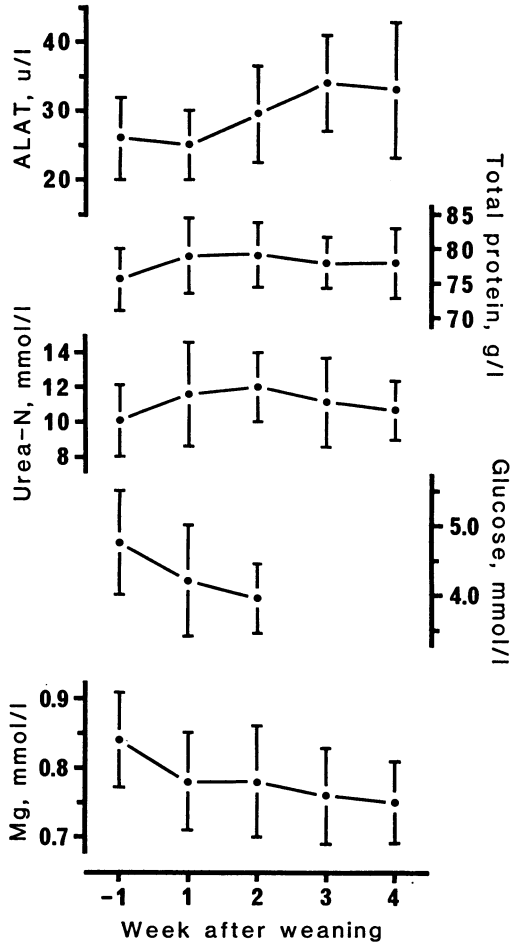


Figure 2. Plasma values (mean ± s) of some blood constituents. The values of these constituents changed significantly during the period studied (ALAT*, urea-N, Mg: $P < 0.01$. Total protein, glucose: $P < 0.05$, F-test).

* Alanine aminotransferase.

The concentrations of urea-N increased somewhat in sows with delayed resumption of ovarian activity (Fig. 3). Mean value (± s.e.m.) in the delayed group was 11.6 ± 0.5 mmol/l compared with 9.8 ± 0.5 mmol/l in the normal group ($P < 0.05$, F-test). In sows with normal weaning-to-ovulation period there was no increase in urea-N after weaning as observed in the delayed group. Concerning the other blood constituents no difference

Table 1. Plasma values (mean ± s) of some blood constituents in sows. The values of these constituents did not change significantly during the period studied.

| | Week after weaning | | | | |
|---|---|---|---|---|---|
| | —1 | 1 | 2 | 3 | 4 |
| ASAT*, U/l | 26.3 ± 6.1 | 27.5 ± 5.7 | 25.2 ± 5.9 | 28.5 ± 6.5 | 26.9 ± 5.9 |
| Ca, mmol/l | 2.6 ± 0.1 | 2.7 ± 0.1 | 2.6 ± 0.1 | 2.6 ± 0.1 | 2.6 ± 0.1 |
| Na, mmol/l | 143 ± 3 | 142 ± 4 | 141 ± 5 | 141 ± 4 | 141 ± 4 |
| K, mmol/l | 4.5 ± 0.4 | 4.5 ± 0.3 | 4.6 ± 0.4 | 4.4 ± 0.4 | 4.4 ± 0.3 |

* Aspartate aminotransferase.

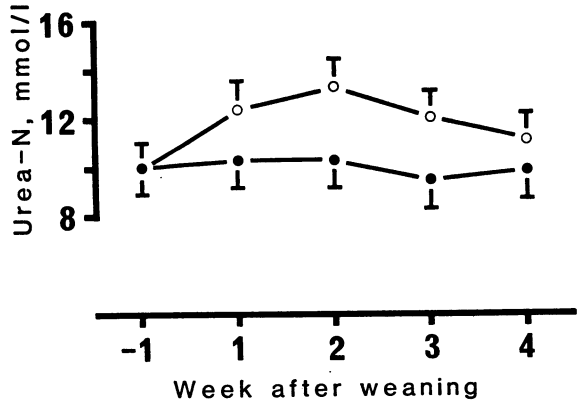


Figure 3. Urea-N (mean ± s.e.m.) in sows with normal weaning-to-ovulation period (● —— ●) and in sows with delayed resumption of ovarian activity after weaning (○ —— ○). Mean value in the normal group was significantly lower than in the delayed group ($P < 0.05$, F-test).

was found between the two groups. No correlations were found between concentrations of the various blood constituents before weaning and the number of suckling piglets.

## DISCUSSION

The ALAT activity in plasma increased significantly after weaning while the ASAT activity remained unchanged. Both ASAT and ALAT activity in swine plasma are found to increase in cases of muscular and liver damage (*Orstadius et al.* 1959). In dairy cows severe post parturient fatty liver has been asso-

ciated with increased ASAT activity. These cows had also longer calving intervals indicating impaired fertility (*Reid & Collins* 1980). The present study does not indicate liver affection in late lactation in the sow. The reason for the increase in ALAT activity after weaning is not known.

The concentration of urea-N and total protein increased during the first two weeks after weaning. The reason for this could be a more adequate protein supply after weaning with respect to the requirement. It has been shown in pigs that when the supply of protein decreased the plasma level and urinary excretion of urea also decreased (*Brown & Cline* 1974), and that protein deficiency reduced plasma protein concentrations in growing pigs (*Lowrey et al.* 1962, *Pond et al.* 1966). *Tewes et al.* (1979) reported decreasing plasma protein concentration in sows during lactation parallel to live weight decrease, and they suggested that inadequate protein intake might have been the reason for this decrease.

Plasma glucose decreased after weaning. Since sows usually are in a positive energy balance after weaning, contrary to the situation in lactation, this was somewhat unexpected and not consistent with the result of *Tewes et al.*, who found a steady decrease in blood glucose level throughout the lactation period. A possible explanation for this could be that the carbohydrate metabolism during lactation is directed towards glucose sparing because of great sugar loss with the milk and a negative energy balance. This could lead to a poor glucose tolerance, and consequently higher plasma glucose concentrations after feeding, that is at the time of sampling in the present study. It has been shown that plasma insulin decreases during fasting in the sow (*Wangsness et al.* 1981). Great individual differences among pigs in the ability to tolerate a glucose load have also been reported (*Bunding et al.* 1956).

Circadian plasma glucose levels did not indicate that another time of sampling might have given different results (Fig. 1). However, the study of circadian variations was performed in post weaning sows, and other results might have been obtained in lactating sows.

Plasma concentrations of magnesium were lower after weaning than during lactation, probably because of reduced food consumption and consequently lower magnesium intake. The plasma concentrations of calcium, sodium and potassium were very

stable during the period studied, indicating an effective homeostatic mechanism for these blood constituents.

Of the blood constituents studied only urea-N concentrations were different in sows with delayed resumption of ovarian activity after weaning compared with the values in sows with normal weaning-to-ovulation period (Fig. 3). In the delayed group urea-N concentrations increased during the first two weeks after weaning, but then decreased somewhat. In the normal group no change in urea-N was observed after weaning. The difference between the two groups is difficult to interpret. According to the discussion above, the sows in the delayed group might have received more food than the others. A possibly higher incidence of thin sows in the delayed group may explain such a difference in food supply. Neither exact food consumption recordings nor body condition recordings were performed in the present study. However, the possibility of a transient difference in the protein metabolism between the two groups should not be excluded. Progesterone, which was produced shortly after weaning in the normal group, has been shown to have an anabolic effect (*Hervey & Hervey* 1967). Thus, the absence of progesterone in the delayed group could lead to higher urea-N concentrations compared with the normal group. On the other hand the possibility also exist that the more anabolic state per se promoted the ovarian activity in the sows with normal weaning-to-ovulation period.

In the present study all sows were kept under the same conditions. Less homogenous results would probably have been found if blood profiles in sows from different herds with different management had been studied. Under such circumstances other relations between reproduction and blood profiles might have been observed. Further studies are therefore necessary to evaluate the usefulness of multiple blood analyses in practical pig farming.

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## SAMMENDRAG

*Plasmabestanddeler hos purke. Mineraler, glukose, urea-N, protein og transaminaser i relasjon til avvenning.*

Konsentrasjonen i plasma av total protein, urea-N, Ca, Mg, Na og K og aktiviteten av aspartat aminotransferase (ASAT) og alanin aminotransferase (ALAT) i plasma ble undersøkt hos 20 purker i tiden en uke før avvenning til 4 uker etter avvenning. Ti av purkene gjenopptok ovarialfunksjonen innen 10 dager etter avvenning, mens de resterende 10 purker hadde forsinket ingangsettelse av ovarialfunksjonen. Plasma glukose ble undersøkt hos 10 purker fra 1 uke før avvenning til 2 uker etter avvenning. Halvparten av disse purkene hadde forsinket igangsetting av ovarialfunksjonen. Konsentrasjonen av total protein og aktiviteten av ALAT steg etter avvenning, mens konsentrasjonen av plasma glukose og Mg sank. Med hensyn til ASAT, Ca, Na og K var det ingen forandringer i løpet av den undersøkte perioden. Det var en tilsynelatende forbigående økning i urea-N nivået i de to første ukene etter avvenning hos purker med forsinket igangsetting av ovarialfunksjonen. Hos purker som gjenopptok ovarialfunksjonen til normal tid ble det ikke observert noen forandring i konsentrasjonen av urea-N etter avvenning. Forskjellen i urea-N var den eneste forskjellen som ble funnet mellom purker med normal ovarialaktivitet og purker med forsinket igangsetting av ovarialaktivitet etter avvenning.

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