THE EFFECT OF THE INGESTION OF DESICCATED PLACENTA ON THE VARIATIONS IN THE COMPOSITION OF HUMAN MILK DURING THE FIRST ELEVEN DAYS AFTER PARTURITION.

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INTRODUCTION.

In order to arrive at any conception of the factors underlying mammary secretion it is necessary to differentiate between the period of development of the mammæ, the period of their hypertrophy during pregnancy, and the period of secretory activity after parturition. From the standpoint of biochemistry the third period is one of special importance.

The influence of the placenta on the secretion of milk has been the object of attention of several investigators. Fellner (1) and Biedl and Königstein (2) seem to think that repeated injections of placental extract tend to cause hypertrophy of the gland, yet neither Kreidl and Mandl (3) nor Frank and Unger (4) could observe this effect. From the researches of O'Donoghue (5, 6, 7) and of Ancel and Bouin (8) it is evident that the internal secretion of the ovaries is the most important factor in the preparation of the mammary gland for the assumption of its function.

Niklas (9) gives a comprehensive bibliography of the observations on the effect of placenta on milk secretion from the quantitative standpoint. Basch (10), Lederer and Pribram (11), Aschner and Grigoriu (12), and Niklas (9) claim that an increased secretion of milk usually occurred as the result of the injections of placental extract. Fieux (13), Lane-Claypon and Starling (14), Biedl and Königstein (2), Mackenzie (15), and Gaines (16) fail to find such an increase. In fact both Mackenzie and Gaines report an inhibition. Feeding experiments have given similar inconstant results. On women the increase was usually of but slight degree only.

Letulle and Larrier (17) consider that the active substance came from the syncytium, while Ercolani (18), Creighton (19), and Pinoy (20) claim that it is the result of the degenerative changes in the placenta.

As the natural result of these observations there are two sets of ideas regarding the part played by the placenta in milk secretion. The one initiated by Hildebrandt (21) and supported by Halban (22) rests upon the negative results, and considers that during pregnancy the placenta gives off a substance inhibitory to the secretory activity of the mammary gland, but excitatory as regards its hypertrophy, with the complementary idea that the removal of this inhibitory stimulus results in secretory activity. A chalone action is thus attributed to the placental secretion. The other, probably best expressed by Niklas, considers that at delivery there is an overflowing of hormones into the maternal blood, which after a certain period of incubation bring about the initiation of the activity of the milk-producing cells, and which in all probability come from the placenta.

It would appear from the foregoing that a chemical study of the composition of human milk when produced under the influence of placental ingestion would be of some assistance in determining whether or not the activity partakes of the type of a chalone or hormone. It would likewise show in some degree the influence of the placenta upon the maternal metabolic changes preparatory to the taking on of a food-producing function.

In a previous paper (23) a somewhat detailed report was given of the variations in the chemical composition of human milk during the first 11 days after parturition. The present paper is a report of the changes induced in these variations by the oral administration of desiccated placenta.

The subjects of this experiment were healthy patients in the Los Angeles County Hospital. Throughout the period of study the diet was the same for all, and was the same as for those previously reported, with the exception that 0.6 gm. of desiccated placenta was ingested three times a day, commencing with the day of delivery. The milk production of eight women was studied.

Case.	Date.	Case.	Date.
	1916		*1917*
1	Aug. 28–Sept. 5	5	Feb. 10–18
2	" 29– " 6	6	" 13–21
3	" 29– " 6	7	" 13–21
4	" 30– " 7	8	" 25–Mar. 5

The milk was collected by means of the breast pump at the same hour on the 3rd, 5th, 7th, 9th, and 11th, days after parturition.

Methods.

Preparation of the Placenta.—The fresh placenta was ground to a pulp in a meat grinder, mixed with 5 to 10 cc. of toluene, and spread in a thin coat over a large glass plate. It was then dried, without decomposition, in about 48 hours, to a leathery, semi-brittle mass, using the air current from an electric fan. This material was then ground as fine as possible and dried for 24 hours over sulfuric acid in a partial vacuum at room temperature. Regrinding resulted in a fine dry powder of uniform consistency and a not unpleasant odor. This powder was administered in capsules.

Analyses.—The analytical processes used were the same as those given in the report on normal milk secretion (23).

Total Nitrogen and Protein.

Total nitrogen only was determined and the protein calculated from these figures by multiplying by the factor 6.37. With the exception of the 3rd day the ingestion of placenta has the effect of increasing the per cent of protein in the milk about 12 per cent. It apparently causes a lowering of the initial protein per cent in colostrum. The results are recorded in Table I.

TABLE I.

The Percentage of Protein in Human Milk on the 3rd, 5th, 7th, 9th, and 11th Days after Parturition, when Desiccated Placenta Is Fed.

Subject.....	1.	2.	3.	4	5.	6.	7.	8.	Average.	High.	Low.
Day.	Protein.										
3rd	2.11	6.08	3.44	1.90	2.22	2.24	2.32	2.68	2.87	6.08	1.90
5th	1.64	1.85	2.52	1.56	1.82	1.79	2.22	2.09	1.94	2.52	1.56
7th	1.55	1.83	2.87	1.86	1.72	1.60	2.06	1.77	1.91	2.87	1.55
9th	1.41	1.86	2.95	1.90	1.52	1.93	2.12	1.70	1.92	2.95	1.41
11th	1.20	1.82		1.42	1.61	1.38	2.02	1.33	1.54	2.02	1.20
Average.	1.58	2.69	2.95	1.73	1.78	1.79	2.15	1.91	2.04	3.29	1.52

Group Variations for Each Day.—In 88 per cent of the cases on the 3rd day the extreme limit of variation from the mean is ± 29 per cent, which is 40 per cent less variation than that found when no placenta is fed. This limit undergoes a slight narrowing on the 5th day, but from then on expands, so that by the 11th day of lactation the variation from the mean is ±25 per cent, almost equal to the initial limit and nearly 40 per cent greater than normal.

Group Variations from Day to Day.—From the 3rd to the 11th day of lactation there is a general fall in protein production, the most marked decline taking place between the 3rd and 5th days. It should be noted that, as with normal protein production, there is also here an evident tendency towards an increase in protein per cent between the 7th and 9th days. This increase is of sufficient frequency to denote the presence of some important change taking place in the protein production mechanism at this time. Qualitatively, therefore, the ingestion of placenta fails to alter the usual course of production direction. Quantitatively the decrease in production is of a lesser degree than normal, resulting in a uniformly higher protein per cent in the milk of women ingesting the desiccated placenta.

The Effects of the Ingestion of Desiccated Placenta on the Variations in the Protein Percentage of Human Milk.—The feeding of desiccated placenta to women during the first 11 days of lactation decreases the per cent of protein in colostrum; it increases the production from then on about 12 per cent above the normal; it causes a narrowing of the limits within which this production may be supposed to occur in colostrum, with an evident later expansion of these limits above those normally found; it does not alter the normal changes in production direction at any time; it has practically no effect on the individual variability from day to day; and the plane of protein production remains nearly as uniformly above or below the group average for the single days as when no placenta is ingested.

Fat.

In Table II will be found the per cent of fat in the milk of eight women on the 3rd, 5th, 7th, 9th, and 11th days after parturition, when desiccated placenta is fed.

As a whole, the effect of the ingestion of desiccated placenta on the fat per cent in human milk is the opposite of that produced on the protein. It causes a tendency towards an increase in the per cent of fat in colostrum, with a decrease in the succeeding days, when compared with the milk produced by individuals not subjected to its influence.

The Effects of the Ingestion of Desiccated Placenta on the Variations in the Fat Percentage of Human Milk.—The feeding of desiccated placenta to women during the first 11 days of lactation tends to decrease the per cent of fat in milk; it causes an expansion of

TABLE II.

The Percentage of Fat in Human Milk on the 3rd, 5th, 7th, 9th, and 11th Days after Parturition, when Desiccated Placenta Is Fed.

Subject.....	1.	2.	3.	4.	5.	6.	7.	8.	Average.	High.	Low.
Day.	Fat.										
3rd	2.26	7.06	3.32	4.14	3.72	2.88	4.88	6.53	4.35	7.06	2.26
5th	1.44	2.94	1.89	2.57	3.89	3.08	4.80	2.30	2.58	4.80	1.44
7th	2.10	3.30	4.41	2.59	2.14	3.69	8.88	2.67	3.72	8.88	2.10
9th	4.09	2.36	3.10	1.74	1.93	2.46	4.84	3.52	3.00	4.84	1.74
11th	2.72	3.98		2.71	2.63	3.62	6.30	4.17	3.73	6.30	2.63
Average.	2.52	3.93	3.18	2.75	2.86	3.15	5.94	3.84	3.48	6.38	2.03

the limits within which the production may be supposed to occur in colostrum; it causes a later narrowing of these limits below those normally found; it tends to regulate the variation in production direction; it increases the individual variability to a marked extent; and it causes the plane of fat production to tend towards uniformity to a greater degree than is found in the milk of individuals not subjected to its influence.

Lactose.

In Table III will be found the per cent of lactose in the milk of eight women on the 3rd, 5th, 7th, 9th, and 11th days after parturition, when desiccated placenta is fed.

TABLE III.

The Percentage of Lactose in Human Milk on the 3rd, 5th, 7th, 9th, and 11th Days after Parturition, when Desiccated Placenta Is Fed.

Subject.....	1.	2.	3.	4.	5.	6.	7.	8.	Average.	High.	Low.
Day.	Lactose.										
3rd	6.49	6.37	5.74	5.16	4.47	5.73	5.88	5.83	5.71	6.49	4.47
5th	7.00	6.20	6.49	6.81	5.47	6.12	6.26	6.63	6.37	7.00	5.47
7th	7.19	7.00	4.05	7.03	6.56	6.44	5.98	6.56	6.35	7.19	4.05
9th	7.53	7.14	5.58	7.20	6.66	6.69	5.75	5.98	6.57	7.53	5.58
11th	7.37	7.03		7.24	6.86	6.86	6.01	5.85	6.75	7.37	5.85
Average.	7.12	6.75	5.47	6.69	6.00	6.37	5.98	6.17	6.35	7.12	5.08

A comparison of the per cent of lactose found in the milk of women during the first 11 days of lactation, with and without the ingestion of placenta, will demonstrate that in the former there has been a consistent increase in sugar production.

The Effects of the Ingestion of Desiccated Placenta on the Variations in the Lactose Percentage of Human Milk.—The feeding of desiccated placenta to women during the first 11 days of lactation causes an increased activity of the lactose-producing mechanism with the consequent generally higher sugar per cent in the milk; it does not alter to an appreciable extent the variability of the limits within which this production may be supposed to occur; although decreasing the individual variability, it seems to cause a slight instability of the usual normal uniformity of change in production direction, an effect opposite to that observed on fat; it causes a diminution of the normal tendency towards a uniformity of plane of production, again different from what occurs with fat.

Variations in the Constituents.

With the decrease in the plane of production for fat there is an increase in the plane of production for both protein and lactose when these results are compared with those obtained during normal milk secretion. The reciprocal relationship existing between fat and lactose production in normal milk when calculated from the individual per cent variation from day to day and the per cent change in production direction is not as well marked under the influence of ingested desiccated placenta. This is due in part to the decrease of the uniformity of change in production direction, and in part to the decrease in per cent variability from day to day, of the lactose production. The alteration in the plane of production of these two constituents seems to have a tendency towards compensating their individual reciprocal variability, which, however, does not in the least signify that they are not still mutually interdependent.

SUMMARY.

In comparing the variations in the fat, protein, and lactose per cent of milk produced during the first 11 days after parturition, when desiccated placenta is fed, with the variations observed

in these constituents for a similar period in normal milk, it is seen that there are some significant differences. Quantitatively the plane of production for lactose and protein has been raised, while that for fat has been slightly decreased. The general change in production direction remains the same.

When we consider as an index of variability the individual variation per cent from the group average for the single days and the individual variation per cent from day to day, the constituents fall into the same order of decreasing variability as in normal milk production; *fat, protein, lactose.* But when the group changes in variation limits and the group uniformity of change in production direction are considered, the order changes from *fat, lactose, protein,* as found in normal milk, to *lactose, fat, protein,* with but slight differences between them.

The tendency for the production plane to be fixed for the individual and independent of the plane of nutrition is here maintained, though to a slightly less extent.

CONCLUSIONS.

The results recorded in this paper demonstrate that the ingestion of desiccated placenta has an effect upon the factors concerned in the regulation of the chemical composition of milk. There is a stimulation of the sugar- and protein-producing mechanism with an apparent depression of the function of the fat-secreting apparatus.

From the peculiar characteristics of milk protein and carbohydrate it is presumable that these constituents are largely elaborated by the gland itself.

There is certain evidence pointing to the idea that the milk fat is not entirely elaborated in the mammary gland. In working with goats, Winternitz (24, 25) and Bowes (26) have shown that probably a part of the ingested fat is carried as such to the mammary gland and then by excretion becomes a milk constituent. Eckles and Palmer (27, 28) clearly show that for the cow there is a variation in the nature and composition of milk fat dependent in some degree upon the diet. The probability of there being present in the gland a specific fat production mechanism for the elaboration of the fats peculiar to milk cannot be denied even though Bradley (29) failed to detect the presence of a lipase in

this tissue. It would therefore appear that milk fat is the sum total of the secretory and excretory activities of the mammary gland, the former being concerned with the elaboration of the fat peculiar to milk, the latter concerned in the inclusion in the milk of a part of the ingested fat as such. The evidence for this is admittedly incomplete.

From the fact that the ingestion of desiccated placenta tends to produce a milk of greater uniformity in change of production direction of fat, it does not seem improbable that its action may well be stimulative to the secretory activity of the gland in this respect also. The cause of the lower per cent of fat in the milk may indeed be founded either in a decreased absorption of ingested fat or in a decreased fat excretory activity of the gland.

These findings seem to lend support to the hypothesis of Niklas (9).

No chalone activity is evident.

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