The composition of chinchilla milk

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1. The composition of the milk of *Chinchilla chinchilla chinchilla* was determined throughout lactation in twenty-eight chinchillas. The amino acid pattern of the protein and the fatty acid composition of the milk were determined, and the effect of three different diets on the milk composition was studied.

2. The milk contained (g/kg): 64–80 protein, 108–156 fat, 17 lactose and 10 ash.

3. Paper and polyacrilamide gel electrophoresis showed four additional protein fractions that are not apparent in bovine milk protein.

One of the problems faced by chinchilla breeders is the high death rate of kits. This often seems to be due to poor milk secretion by the mothers. The authors are unaware of reports describing the composition of chinchilla milk throughout lactation. The study reported here was undertaken to determine the composition of the milk of the chinchilla throughout lactation with a view to preparing a suitable milk replacer. The composition of the milk of chinchillas, given three different concentrate mixtures, was compared.

METHODS

Chinchillas (*Chinchilla chinchilla chinchilla*, formerly *C. brevicaudata*) were kept in families in cages made of wire-netting. Water and hay were supplied *ad lib.* and pelleted concentrates containing 170 g protein/kg and 40 g fat/kg were supplied once daily to the twenty control animals. In addition, two experimental diets were prepared by varying the amounts of soya-bean cake and soya-bean oil in the concentrate so that one contained 140 g protein/kg and 80 g fat/kg, and the other 210 g protein/kg and 80 g fat/kg; these diets were given to groups of four animals. The fatty acid composition of the dietary fat was (parts/10^3): 14:0, 5; 16:0, 138; 18:1, 234; 18:2, 546; 18:3, 67. Milk was obtained, after removal of the kits for 3–4 h, by an intravenous injection of oxytocin (2 i.u.) followed by manual milking starting 1 min later. This procedure was carried out daily after parturition until milk secretion ceased. Samples for analysis were stored at $-18°$.

The nitrogen content of the milk was determined after digestion as described by Conway (1957), and the NH_3 was determined after dilution to 5 ml with a Technicon AutoAnalyzer (Technicon Chromatography Corp., New York, USA) as described by Clare & Stevenson (1964). Paper electrophoresis was carried out with a veronal buffer pH 8·6 at 200 V for 16 h at 4–5°; amido black was used to make spots visible. Electrophoresis on polyacrilamide gel as described by Reisfeld, Lewis & Williams (1962), Davis (1964) and Ornstein (1964) was also used. Electrophoresis was done on some

Table 1. *Composition (g/kg) of chinchilla milk throughout the lactation*

(Mean values and standard deviations for the twenty animals receiving the standard diet)

Day *post partum*	Protein		Fat		Lactose		Ash	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0	64	18	156	31	16	3	9·5	0·7
1	67	16	125	29	16	4	9·5	0·8
3	70	8	115	36	17	2	10	1·3
5	74	7	108	34	17	3	9·8	1·0
7	76	8	113	35	17	2	10	0·9
9	80	8	125	33	17	2	10	1·0

Table 2. *Amino acid composition (parts/10^3 of total amino acid) of chinchilla total milk protein*

(Mean values and standard deviations for five animals 1–3 d *post partum* receiving the standard diet)

Amino acid	Chinchilla's milk		Cow's* milk
	Mean	SD	
Aspartic	84	16	74
Threonine	54	5	43
Serine	69	4	56
Glutamic	167	21	215
Proline	19	5	88
Glycine	37	10	19
Alanine	83	11	34
½Cystine	17	1	8 (cystine)
Valine	65	1	56
Methionine	24	4	24
Isoleucine	46	2	46
Leucine	100	10	92
Tyrosine	40	5	46
Phenylalanine	39	9	52
Lysine	87	28	78
Histidine	31	6	26
Arginine	37	5	32

* Values from FAO (1970).

samples of the precipitate and filtrate that were formed on acidifying the milk to pH 4·6. Amino acid composition of the total milk protein was determined after acid hydrolysis using an amino acid analyser (B.C. 200, Biocal I. G. München-Grafelfing, Germany) as described by Moore, Spackman & Stein (1958).

The amount and composition of the fatty acids were determined after extraction of the fat from the milk as described by Folch, Lees & Stanley (1957), addition of heptadecanoic acid (Applied Science Inc.) as internal standard, transmethylation and gas–liquid chromatography as described by Sklan, Volcani & Budowski (1971), using a Hewlett–Packard 409 gas chromatograph.

Sugar content was determined by the method of Roe (1955).

Ash was determined gravimetrically after heating to 600° to constant weight.

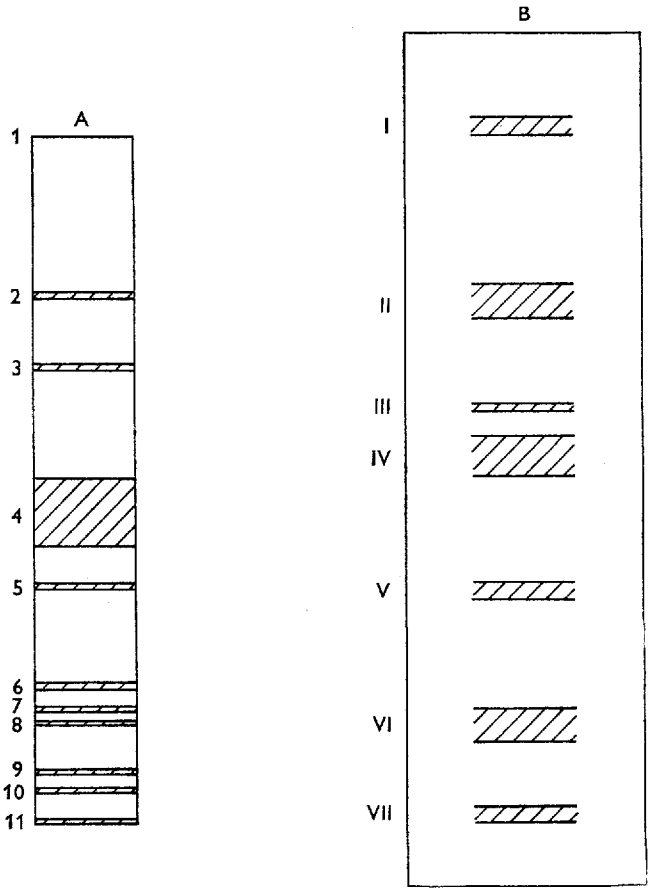

Fig. 1. Electrophoresis of chinchilla milk protein. (A) On polyacrilamide gel: 1, origin: fractions 2, 3, 8, 9 not apparent in bovine milk protein. (B) On paper: I, origin and negative migration; fractions I, II, VI and VII not apparent in bovine milk protein.

RESULTS

In most mothers two nipples were found to secrete milk although, in mothers with four or more kits, four secreting nipples were sometimes found, two of which secreted most of the milk. Typical total yields from all active nipples were 1–2 ml; on occasions as much as 5 ml were obtained, with a maximum at 2–3 d after parturition. Milk was not obtainable from most females after 10 d.

The composition of the milk throughout the lactation for animals on the standard diet is given in Table 1. The protein content of the milk increased from 64 g/kg on the day of parturition to 80 g/kg on the 9th day of lactation. The fat content on the day of parturition was 156 g/kg, this decreased to 108 g/kg on the 5th day *post partum* and rose again to 125 g/kg on the 9th day of lactation. Lactose and ash remained fairly constant at 17 and 10 g/kg respectively

Electrophoresis on both paper and polyacrilamide gel (Fig. 1), showed two zones appearing close to the origin and before the γ-casein; these zones appeared in the

Table 3. *Effect of three different diets (A, B and C) on the protein, fat, lactose and ash content, and the fatty acid composition of chinchilla milk obtained during days* 1–4 post partum

(Diets A, B and C contained 170, 140 and 210 g protein/kg, and 40, 80 and 80 g fat/kg respectively. Mean values and standard deviations; numbers of animals in parentheses)

	Diet A (20)		Diet B (4)		Diet C (4)	
Component	Mean	SD	Mean	SD	Mean	SD
Protein (g/kg of milk)	72	3	71	4	79	3
Fat (g/kg of milk)	125	8	148	24	151	47
Lactose (g/kg of milk)	16	4	18	6	16	5
Ash (g/kg of milk)	9	2	9	3	9	4
18:2 (parts/10^3 of fatty acids)	239	13*	346	4	366	7
18:0+18:1 (parts/10^3 of fatty acids)	369	11*	325	21	301	16

* Significantly different ($P < 0.01$) from those values obtained with the other diets.

fraction precipitating at pH 4·7 and were possibly immunoglobulins or proteose–peptone. Two additional zones migrating further than the α-casein were also present; these do not occur in the protein of cow's milk. The two zones close to the origin became less pronounced as lactation progressed. A slight migration towards the anode was detected on paper electrophoresis. The amino acid content of the total protein is shown in Table 2.

The milk fat contained (parts/10^3) < 10 of fatty acids of chain length shorter than myristic acid, 30, 14:0; 300, 16:0; 352, 18:1; 268, 18:2; and 29, 18:3. No significant changes in fatty acid composition occurred during the lactation.

The effect of the three different diets on the milk composition is shown in Table 3. The protein, fat, lactose and ash contents of the milk were not altered significantly by the different diets whereas the fatty acid composition of the milk was significantly affected. For the diets containing 80 g fat/kg, the proportion of 18:2 fatty acids in the milk were increased at the expense of 18:0 and 18:1 fatty acids.

DISCUSSION

The fat content of chinchilla's milk is similar to that of rabbit's milk (Coates, Gregory & Thompson, 1964) and higher than that found in milk of rats, guinea-pigs and mice. Protein and lactose content however, are lower than those found in any of the above species (Jenness & Sloan, 1970).

The effect of the various diets on the fat, protein, lactose and ash content of the milk was not found to be significant although extreme variations in the diet would be expected to affect the milk composition. The lower 18:2 content of the milk from animals fed on the lower-fat diet is not surprising as less of this essential fatty acid was being supplied to the animal and thus less appeared in the milk.

Several fractions which are not present in cow's milk appear on electrophoresis of the protein of chinchilla milk; however, further work is required to identify these fractions and assess their nutritional value. The amino acid composition of the protein

shows a slightly larger proportion of essential amino acids than in cow's milk (483 compared with 445 parts/10^3) (FAO, 1970); however, less phenylalanine, proline and glutamic acid; and more threonine, valine, serine, alanine and glycine are present.

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