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Development of a dried colostrum

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ABSTRACT

The effects of various storage/drying procedures of bovine colostrum on the absorption of bovine serum immunoglobulin (Ig) by neonatal kids was examined. Kids either suckled their dams at birth (control) or were fed warmed liquid bovine colostrum which had been either frozen/thawed, frozen/freeze dried or spray dried. After 4 d on treatment protein analysis showed Ig of bovine origin to be present in the serum of all kids fed bovine colostrum. Kid growth and health were good, and did not differ between treatments. Results suggest that the spray process will provide a dried product with the biological properties of unprocessed colostrum.

Keywords Bovine colostrum; processing; freezing; freeze drying; spray drying; Ig absorption; kids.

INTRODUCTION

A commercially available colostrum, presented in a portable dried form, could have 3 possible applications; for the provision of passive immunity in those situations where the dam's colostrum was not available at birth, as a feeding supplement to enhance growth and health in neonates and as an aid to preventing the colostrum mediated transfer of disease from dam to offspring. The latter application may be opportune where kids are removed from does immediately after birth to prevent the transfer of the caprine arthritis-encephalitic (CAE) retrovirus via the dam's colostrum. The potential applications are enhanced by cross reactivity of bovine colostrum with kids, lambs and piglets in providing serum immunoglobulin (Ig) and disease protection. Further, it has been shown that neonates fed colostrum for extended periods after birth grow at higher than normal rates (Clayton, 1963), with recent findings indicating colostrum may contain various growth factors (Brown and Blakely, 1983). These findings may have commercial implications for the development of a dried colostrum product.

The development of a portable dried product requires, in the first instance, the establishment of a drying process which provides product with adequate biological activity. Several storage/processing techniques were compared in the current experiment in which bovine colostrum was fed to colostrum-deprived neonatal Saanen kids, and measurements made of serum proteins, health and growth.

EXPERIMENTAL

Colostrum was collected from several cows which had calved less than 36 h earlier, bulked, and held at 5 to 8°C until processed. The bulk was mixed and one third dried by spray process and two thirds frozen to -18°C. Half of the frozen colostrum was subsequently freeze dried under conditions which did

not allow product temperature to rise above 40°C. Spray drying conditions were: inlet temperature 118°C, outlet temperature 65°C, solids of inward product 17%, solids of dried product 92%. Composition of the bulk colostrum was 4.0% fat, 10.1% protein and 3.8% lactose.

The colostrum was fed to 60 Saanen kids which were born over the period 5 August to 1 September 1986 and allocated to the following treatments.

Control:

Suckle dam from birth for 1 d. Thereafter to day 4 fed 300ml bulked goat's colostrum, twice daily by teat. Colostrum warmed by adding 50 ml hot water.

Frozen/thawed:

Removed from dam at birth and fed 300 ml thawed cow's colostrum, twice daily by teat for 4 d. Colostrum warmed by adding 50 ml hot water.

Frozen/freeze dried:

Removed from dam at birth and fed 300 ml cows' colostrum reconstituted to 12.5% solids, twice daily by teat for 4 d.

Spray dried:

Removed from dam at birth and fed 300 ml cow's colostrum reconstituted to 12.5% solids, twice daily by teat for 4 d.

Feeding was at 0700 and 1550 h. Kids were allocated across treatments with related animals split between treatments. Animals on the control treatment were mostly born at night when it was not possible to wean prior to suckling. Kids were penned in treatment groups in a barn with supplementary heating for the first 4 d, thereafter they were transferred to a second barn and managed as a common group with access to pasture and an automatic milk feeder until they were 29 days of age. The kids were fed milk replacer (Ancalf Plus; New Zealand Co-op Dairy Company) reconstituted to 12.5% solids with an effective average intake of 342

g milk powder/kid/d. From 29 to 56 days of age the kids were fed fresh cow's milk *ad libitum* by cafeteria with a resulting intake of 3.31 L/kid/d. Meal was available throughout.

Kids were weighed at allocation to treatment and weekly thereafter. Excepting kids on the control treatment, a 5 ml jugular blood sample was taken prior to the first feed; another 5 ml sample was collected from all kids at 1200 h on the fourth day. Serum was analysed for total protein (Folin-Ciocalteus); Ig specifically of bovine origin by immuno-diffusion (Coltest TM) in which caprine antisera formed the binding protein; and the serum protein proportions of albumin and gamma-globulin by electrophoresis (Helena Cliniscan).

A record was kept of kid health. Data from kids that died was excluded from the analysis.

RESULTS

Growth and Health

Initial live weight averaged 3.9 kg, and after 4 weeks on treatment the treatment group means were control (n=14) 11.2 kg, frozen/thawed (n=15) 11.0 kg, frozen/freeze dried (n=15) 10.5 kg and spray dried (n=14) 11.3 kg respectively with an average standard deviation of 1.6 kg. Rate of daily gain did not differ between groups and averaged 252g/d over the 4 week period.

Digestive disturbance in the form of scours was minimal. Seven kids died. The treatment group breakdown was: control 3 (1 at 6 weeks from unknown cause but with manifest spasms and slowed growth, 1 on day 3 and 1 on day 4 from pneumonia); frozen/thawed 2 (1 on day 10 from peritonitis as a result of anal blockage and 1 on day 5 from pneumonia); frozen/freeze dried 1 (twisted bowel on day 47); spray dried 1 (cause unknown, but exhibited spasms on day 32).

Blood Protein Assays

At day 0 the averages were serum protein 5.4%, albumin 63%. γ -globulin 9%, albumin 3.4 g% and γ -

globulin 0.4 g%. At day 4 the bovine Ig specific assay gave a zero result for control animals (Table 1), and there was, for the other 3 groups, a treatment effect with a decline in level moving from thawing and freeze drying to spray drying. By day 4 serum protein content had risen from around 5% prior to consuming any colostrum to 6.5 to 8.0%. Part of this rise would be due to colostrum proteins entering the serum; treatment had a significant effect on serum protein content.

By day 4 serum albumin had declined by around 15 units from the initial mean of 63%. Although albumin would not be expected to reflect colostrum proteins, it did show a treatment effect due to its proportional composition in serum. The trend was consistent with γ -globulin content, the other serum protein, which showed a major treatment effect. When converted to a weight percent basis albumin showed no overall treatment effect. However o-globulin was affected by treatment, with the spray and freeze drying treatments lowering ($P<0.05$) its content compared with control animals.

DISCUSSION

In assessing the effect of processing on the absorption of immunoglobulins, the 3 criteria monitored in this experiment were serum proteins, health and growth.

The bovine Ig specific assay showed clearly that immunoglobulins of bovine origin were assimilated for all 3 processing treatments. This was supported by the γ -globulin results (Bush and Staley, 1980) which showed a 2-fold increase from time 0 to day 4. The correlations between bovine Ig and γ -globulin % and γ -globulin g% were respectively 0.77 and 0.83, indicating a measure of association. γ -globulin % and g % were higher for control than treatment groups. Assuming this difference derived from absorbed Ig, it may have had 2 sources. Firstly, in calves it has been shown the absorption of Ig is influenced by the presence of the dam at suckling (Ternouth, 1986) and secondly it seems possible that

TABLE 1 Serum protein results for day 4.

Serum protein	Treatment				SED	Treatment effect
	Control	Frozen/ thawed	Frozen/ freeze dried	Spray dried		
Bovine Ig	0	2.9	2.5	1.8	0.3	**1 ^a
Serum protein (g%)	8.0	7.3	7.6	6.5	0.6	**
Albumin (%)	45.7	51.3	54.4	56.8	2.0	***
γ -globulin (%)	26.2	21.7	17.8	14.0	2.8	**
Albumin (g %)	3.5	3.7	4.2	3.7	0.2	NS
γ -globulin (g %)	2.3	1.6	1.4	1.0	0.3	**

¹ Analysis carried out excluding control treatment.

the assimilation of Ig sourced from another species might be less efficient than for Ig from the maternal species. The frozen/thawed and frozen/freeze dried treatments yielded generally similar results for all serum protein measurements. Compared with these 2 treatments spray drying resulted in lower bovine Ig and γ -globulin. This is assumed to be due to the spray process being more rigorous than freezing/thawing and freezing/freeze drying.

Generally kid health and growth were very satisfactory. Deaths were few, and did not differ between treatments. The incidence of diarrhoea was minimal.

The results of this experiment indicate therefore that spray drying, as well as freeze drying, are satisfactory means of dewatering colostrum to produce a product retaining properties of passive immunity. However there was no specific disease challenge applied and since kids were reared to a relatively high standard of management, with a minimal stress of wet and cold, it cannot be concluded that adequate disease protection would be provided under more stressful rearing conditions. Further tests are required under more challenging

circumstances, along with specific microbiological assessment, to establish if the spray-dried product supports disease protection as well as Ig absorption.

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