3873

TECHNICAL NOTES

Effect of Instantizing on Amino Acid Content of Nonfat Dry Milk

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Abstract

Commercial production of instantized skim milk powders by rehydration, agglomeration, and redrying of spray dried powder or by direct conversion of a skim milk concentrate to instant powder in a single step resulted in no marked loss of amino acids. One instant powder in which moisture content exceeded U.S. grade standard lost small amounts of lysine, methionine, and cystine during instantizing.

Introduction

The U.S. Department of Agriculture price support operations involve procurement and distribution of spray dried and instantized skim milk. The instantized product is usually made in a multistep process involving rewetting, agglomeration, and redrying of spray dried material (16). However, methods recently developed allow instantized products to be made from concentrated skim milk in a single pass through a drier. Details of these methods are not available, but information on processing conditions in the manufacture of the single-stage instantized powder used in our study is in patents (12, 13).

Little or no change in milk constituents occurs during instantizing (6, 7). However, instantized skim milk powder distributed by USDA may be nutritionally inferior to the regular spray dried product in the commodity distribution program (3). These results conflict with the earlier studies (6, 7). The literature contains no data describing the effect of present large-scale instantizing operations on the composition of milk constituents.

Some amino acids essential for growth can be degraded easily by a combination of heat and moisture, especially in the presence of reducing sugars such as lactose (11). We measured the change in amino acids of milk during instantizing operations.

Materials and Methods

Samples of milk powder entering and exiting from instantizing equipment located in three different commercial plants engaged in multistep instantizing, were picked up on site. Cold samples of skim milk concentrate along with samples of the instantized product made from the concentrate by a single pass through drying equipment were analyzed.

Protein was determined by a standard micro-Kjeldahl procedure using the factor of 6.38 (1). Total solids in the condensed skim milk were measured by the Mojonnier method. Moisture was determined by drying in a vacuum oven (80±20 mm Hg) for 16 h at 65 C.

Amino acids were analyzed on a Beckman Model 120 C amino acid analyzer in accordance with the method of Spackman et al. (14). Reconstituted samples were hydrolyzed in 6 N HCl at 110 ± 1 C in sealed, evacuated tubes. Aliquots of each sample were hydrolyzed for 22, 46, and 70 h. Cystine was determined as cysteic acid after performic acid oxidation, followed by acid hydrolysis as described by Moore (9). Available lysine was determined as the difference between blocked and total lysine after the procedure of Blom et al. (2). Tryptophan was measured on the powder and lyophilized concentrate by the procedure of Spies (15).

Results and Discussion

Results are summarized in Table 1. Values for cystine and tryptophan are averages of duplicate determinations. Approximate figures for ammonia were from extrapolation to zero time. All other results represent averages of three determinations or the maximum value where appropriate.

The data agree closely in amino acid composition of each paired sample. Serine contents of sample pairs 1 and 2 show increases of 3.6 and 3.4% after instantizing. This is not evidence of an actual increase, however, as all serine values are probably lower in varying degrees than the actual amount because they are uncorrected for hydrolytic destruction as simple extrapolation to zero time content was not possible.

Losses of methionine in sample pair 1 of 3.3% and in sample pair 3 of 4.8% are ob-

TABLE 1. Amino acid composition of nonfat milk samples from four commercial plants (g amino acid/100 g protein).

Amino acid	Sample pair #1		Sample pair #2		Sample pair #3		Sample pair #4	
	base[a]	powder[b]	base	powder	base	powder	base	powder
Lysine	8.45	8.49	8.36	8.38	8.48	8.22	8.52	8.39
Histidine	2.89	2.93	2.92	2.90	2.96	2.90	2.87	2.92
Ammonia	1.99	1.86	1.89	1.98	1.98	1.98	1.45	1.48
Arginine	4.01	3.99	3.78	3.78	3.69	3.69	3.78	3.80
Aspartic acid	8.34	8.28	8.15	8.22	8.04	8.08	8.03	8.00
Threonine	4.43	4.43	4.25	4.26	4.37	4.48	4.66	4.57
Serine	5.56	5.76	5.52	5.71	5.61	5.69	5.76	5.71
Glutamic acid	21.6	21.8	22.0	22.2	21.7	22.0	22.2	22.0
Proline	9.34	9.34	9.42	9.41	9.46	9.46	9.76	9.77
Glycine	2.13	2.15	2.07	2.07	2.09	2.09	2.07	2.09
Alanine	3.44	3.44	3.43	3.51	3.49	3.51	3.45	3.44
Cystine	.72	.72	.65	.65	.66	.63	.72	.72
Valine	6.77	6.74	6.58	6.58	6.77	6.70	6.75	6.76
Methionine	2.75	2.66	2.61	2.66	2.51	2.39	2.72	2.72
Isoleucine	5.40	5.36	4.94	5.05	5.12	5.09	5.63	5.64
Leucine	10.2	10.2	10.1	10.1	10.2	10.2	10.1	10.1
Tyrosine	5.47	5.44	5.34	5.33	5.54	5.53	5.24	5.22
Phenylalanine	5.02	5.02	4.99	5.02	5.09	5.19	5.10	5.15
Tryptophan	1.56	1.58	1.53	1.64	1.56	1.61	1.49	1.54
Available lysine	8.17	8.21	8.13	8.11	8.16	7.89	8.30	8.17
% total solids	...	...	...	...	...	...	38.66	...
% moisture	3.13	3.97	2.69	3.71	5.85	6.27	...	2.42
% protein (N × 6.38) dwb	35.09	34.45	35.61	35.56	36.27	35.74	37.01	36.94

[a] base = powder or concentrate before instantizing.
[b] powder = powder after instantizing.

served. Methionine is subject to degradation by heat (8). Therefore, the observed small decreases indicate minor thermal stress during instantizing.

Sample pair 3 revealed losses in lysine (3.1%) and cystine (4.5%). The instantized powder in this set had the lowest available lysine content of all samples analyzed. However, the moisture content of sample pair 3 was high and that of the instantized product exceeded 4.5% which is the maximum permitted by U.S. Standards for instant nonfat dry milk (4).

Deviation of amino acids within samples was of the order of ± 1.5%; deviation between samples was similar except for the small decreases noted above. Losses in amino acids during processing reflect the negligible changes that could be anticipated based on knowledge from more basic studies of thermal degradation of amino acids (5, 10). Instantizing operations now in commercial use produce negligible changes in the chemical composition of skim milk.

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