COMPARISONS OF COMMERCIAL FROZEN YOGURT WITH KSU FORMULATION

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Summary

Ten samples of vanilla frozen yogurt were purchased in Kansas and compared to a high-protein, KSU formulation. The KSU formulation had similar solids, fat, and sugar contents as the commercial samples. All commercial samples had lower protein (almost less than half) content and more lactose, and almost all samples had fewer lactic acid bacteria than the KSU formulation. All but one commercial sample had lower β-galactosidase activity than the KSU formulation. This may reflect the differing lactic acid bacterial populations in the frozen yogurts.

(Key Words: Frozen Yogurt, Lactic Acid Bacteria, Microbial Quality.)

Introduction

Frozen yogurt is a popular food item that has experienced a 45% increase in rate of growth since 1990. Because there is no adopted standard for frozen yogurt, composition varies considerably. Reasons why consumers choose to eat a frozen yogurt product vary, but the word “yogurt” implies a health benefit to many consumers. One of the health benefits of yogurt is its acceptability by lactose-intolerant individuals. Lactic acid bacteria (LAB), used to manufacture yogurt, produce the β-galactosidase enzyme that degrades lactose to glucose and galactose (preventing the problem of lactose intolerance). People also may elect to consume frozen yogurt for other health reasons such as reduced calorie, fat, or sugar contents. KSU researchers have developed a method to produce a high protein, low lactose, frozen yogurt. This product was compared against 10 commercial brands for overall quality and composition.

Procedures

Ten vanilla frozen yogurt products were purchased from several stores throughout Kansas. Samples were stored at -20 degrees F until analysis. A sample of the KSU product was selected randomly for comparison. The frozen yogurt samples were analyzed for protein, ash, fat, and total solids; titratable acidity (expressed as % lactic acid); and pH according acceptable standards for frozen dairy desserts. Total carbohydrate content was calculated by difference. Total aerobic, coliform, and LAB counts were enumerated using standard procedures. Carbohydrates were separated from the remaining ingredients and prepared for HPLC analysis. The extracts were analyzed for selected carbohydrates: fructose, glucose, lactose, and sucrose. Samples were analyzed for potential amount of β-galactosidase activity.

Results and Discussion

Table 1 shows the composition of the KSU product (KSU) and 10 purchased frozen yogurt samples. Great variability was observed in fat (.9-8.9%), protein (2.7-9.1%) and total solids (25.7-38.8%) contents. The KSU sample had the highest protein content (9.1%). For other components, the KSU sample was in the range of the commercial samples. Several samples selected were labeled as nonfat (Samples C = 2.8, E = 3.0, and I = .9). Samples C and I were low fat, instead of nonfat products, as defined by the federal Nutrition Labeling and Education Act.

Table 2 summarizes the microbial analyses. According to the National Yogurt Association guidelines, yogurt should contain a sufficient quantity of LAB. However, there are no standards for LAB content in frozen yogurt.

LAB are considered to have a positive effect on health. These 11 samples showed variable numbers of LAB, but all contained significant quantities. Total aerobic counts are reasonable considering that these samples may be made from cultured products. There is concern for those products with coliform counts greater than or equal to 1 cfu/ml. Coliforms are used as an indication of unsanitary practices or contamination. The samples with greater than or equal to 1 cfu/ml were purchased at freeze-on-premise operations. These operations should review and change their sanitation practices.

Table 3 shows the physical characteristics of all samples. Yogurt is a fermented product and has a low pH (4.0-4.3). There is no established standard for pH of frozen yogurt, but consumers prefer a product that is not too acidic. The pH and titratable acidity values reflect these preferences. The β-galactosidase enzyme was detected in all samples. Those samples with high β-galactosidase activity had higher LAB counts (Table 2).

Table 4 illustrates the selected sweetener composition of all samples. For people who are lactose maldigesters, the KSU sample had the lowest concentration of lactose. Sample C was labeled as nonsugar and did not contain any sucrose. All other samples contained a variety of sweeteners at various concentrations.

Conclusions

The overall composition and microbial quality varied greatly among frozen yogurt samples, reinforcing the lack of a national guideline or standard for this product. The presence of LAB and β-galactosidase activity indicated that most manufacturers are utilizing a "yogurt" base in their product. The production of a high protein, frozen yogurt seems to fit within the consumer's expectations of a frozen yogurt.

Table 1. Composition of Frozen Yogurt Samples

Sample	Protein	Fat	Selected sugars[1]	Ash	Other carbohydrates[2]	Total solids
			---------- % ----------			
A	3.5	2.6	11.3	1.2	15.4	37.0
B	4.4	6.1	13.6	0.9	11.8	38.2
C	4.4	2.8	5.6	0.9	9.5	25.7
D	4.8	9.0	15.8	1.1	6.3	36.9
E	4.4	3.0	15.6	1.0	7.3	31.3
F	3.6	3.8	17.7	0.8	12.9	38.8
G	3.8	7.8	16.4	0.8	6.3	35.1
H	2.9	3.4	15.0	0.8	9.3	31.4
I	2.8	0.9	15.3	0.8	6.0	25.8
J	3.7	5.5	13.6	0.8	7.6	31.1
KSU	9.1	4.2	12.9	1.0	7.2	34.4

[1]Represents fructose, galactose, glucose, lactose, and sucrose. [2]Carbohydrates excluding fructose, galactose, glucose, lactose, and sucrose.

Table 2. Microbial Quality of Frozen Yogurt Samples

Sample	LAB[1]	Coliform[2]	Aerobic Counts[3]
A	1.3×10^6	<1	2.6×10^5
B	2.6×10^8	<1	3.6×10^7
C	5.5×10^6	100	3.3×10^6
D	1.1×10^8	<1	5.0×10^7
E	1.9×10^8	<1	3.1×10^7
F	3.2×10^8	<1	7.5×10^7
G	2.1×10^9	<1	5.5×10^6
H	6.3×10^6	523	1.4×10^6
I	8.9×10^6	107	1.3×10^7
J	3.4×10^6	1	3.0×10^6
KSU	4.4×10^8	<1	4.0×10^8

[1]Lactic acid bacteria in cfu/ml. [2]Coliform count in cfu/ml. [3]Total aerobic counts in cfu/ml.

Table 3. pH, Titratable Acidity and β-Galactosidase Activity Values of Frozen Yogurt Samples

Sample	pH	Titratable acidity[1]	β-Galactosidase activity
A	6.40	0.29	2.48
B	6.56	0.26	10.60
C	6.71	0.23	1.12
D	6.53	0.32	9.42
E	6.42	0.24	21.94
F	5.76	0.38	43.12
G	5.93	0.38	21.47
H	6.58	0.21	3.42
I	6.65	0.23	1.14
J	6.72	0.20	1.12
KSU	6.11	0.43	27.28

[1]Expressed as % lactic acid.

Table 4. Selected Sweetener Composition of Frozen Yogurt Samples

Sample	Fructose	Glucose[1]	Sucrose	Lactose
	---------- % ----------			
A	0.0	0.7	7.2	3.8
B	0.0	1.3	8.4	3.4
C	0.0	2.2	0.0	3.4
D	0.0	1.3	10.3	4.3
E	1.5	2.5	7.5	4.2
F	0.0	1.9	12.7	3.1
G	0.0	1.2	11.8	3.5
H	0.0	1	10.0	4.0
I	1.6	1.4	8.2	4.0
J	0.0	1.1	8.7	3.9
KSU	0.0	1.1	9.6	2.3

[1]May include galactose.