COMPOSITION, PHYSICAL PROPERTIES AND MICROBIOLOGICAL QUALITY OF CHIP-DIPS[1]

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Chip-dips are a relatively new dairy product on the market. Basically they are flavored cultured creams. Their manufacture in the form of dehydrated base for home preparation and ready-to-serve dips has increased tremendously since their introduction.

To date no federal standards have been established for chip-dips. Regulatory officials in 50 states were queried concerning effective or proposed standards governing the composition and microbiological quality of dips. Officials from 48 states responded. Twenty-six stated that they had no regulations in effect or proposed, but several were planning to implement standards. Fifteen states regulate chip-dips under general food and labeling laws. Four states had rudimentary standards for composition or quality. Two of them limited the coliform count on ready-to-serve dips to 10 per g, one permitted no coliforms and another limited the total bacteria count of dehydrated bases to 50,000 per g.

Since there was no published information concerning the gross composition, microbiological quality or physical properties of chip-dips, examination of those products presently available in the market seemed desirable.

Three classes of dips were analyzed; namely dehydrated base, ready-to-serve, and dehydrated base reconstituted according to the manufacturer's recommendations.

METHODS AND MATERIALS

Source and description of samples

Twenty-six samples of dehydrated chip-dip base representing four brands and 14 flavors, were secured from local markets. Eight additional samples, representing two brands and eight flavors, were obtained directly from the manufacturers. The latter eight samples were of bases manufactured for use by commercial dairy plants in the preparation of ready-to-serve chip-dips.

Fifty-nine samples of ready-to-serve chip-dips, representing six brands and ten flavors were purchased in local markets. Also, 56 samples of dehydrated chip-dips, representing four manufacturers and including 14 flavors, were secured from local markets. These were reconstituted according to directions using the specific products suggested; i. e. water, milk, sour cream, cream cheese, and creamed cottage cheese. In addition to the products recommended for reconstitution, half-and-half and whipping cream were used also. All of the dairy products were purchased from local markets at the same time as the dehydrated bases so as to simulate as closely as possible the actual quality the consumer would encounter.

The net weight of dehydrated base in each package of chip-dip varied from 8 to 71 g or approximately from 0.28 to 2.50 oz. The recommended amount of dairy products to be added varied with each brand also, but was always the same for each flavor within the brand.

Analyses

Appropriate examinations were made on each class of chip-dip for microbiological quality, physical and chemical characteristics and organoleptic score.

Microbiological determinations for total, coliform, psychrophile, yeast and mold counts were made according to Standard Methods *(1)*. The plates for total and coliform count were incubated at 32° and 35°C., respectively, and the psychrophile plates were incubated at 7°C for 7 days.

The dehydrated samples were examined for fat by the Roese-Gottlieb method. Both the reconstituted and the ready-to-serve samples were tested for fat by a modified Babcock procedure employing a quaternary ammonium compound in concentrated sulfuric acid *(7)*. The moisture content of the dehydrated samples was determined with an infra-red moisture balance. The reconstituted and the ready-to-serve samples were dried to constant weight in a 100°C vacuum oven. Total nitrogen was determined by a macro Kjeldahl procedure. pH measurements were made with a glass electrode pH meter. Penetrometer measurements were made with a Universal model Precision Penetrometer at approximately 72°F with the standard petroleum cone. Values are

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TABLE 1— MICROBIOLOGICAL POPULATIONS IN DEHYDRATED CHIP-DIP BASES AND IN READY-TO-SERVE CHIP-DIPS

	34 commercial dehydrated chip-dip bases		59 commercial ready-to-serve chip-dips	
Type of count	Range of counts per gram	Number of samples	Range of counts per gram	Number of samples
Standard plate	<1,000 to 10,000	8		
	>10,000 to 50,000	7		
	>50,000 to 100,000	6		
	>100,000 to 1,000,000	11		
	>1,000,000	2		
Psychrophile			<10 to 10	55
			>10 to 100	3
			>1,000	1
Coliform	<10 to 10	13	<10 to 10	59
	>10 to 100	4		
	>100 to 1,000	11		
	>1,000	6		
Yeast[a]	<10 to 10	27	<10 to 10	18
	>10 to 100	3	>10 to 100	0
	>100 to 1,000	2	>100 to 1,000	3
	>1,000	2	>100,000	4
Mold[a]	<10 to 10	7	<10 to 10	23
	>10 to 100	11	>10 to 100	0
	>100 to 1,000	10	>100 to 1,000	1
	>1,000	6	>100,000	1

[a]Only 25 ready-to-serve samples examined

expressed as the penetration in tenths of a millimeter in five seconds or $\frac{mm}{10}$. Flavor, body, texture and color were rated according to a hedonic scale *(4)* ranging from nine (like extremely) to one (dislike extremely).

RESULTS AND DISCUSSION

Microbiological analyses

The results of the microbiological examination of dehydrated bases and ready-to-serve dips are summarized in Table 1. Eight of the 34 samples of dehydrated base examined had counts of <10,000 organisms per g, 15 of the 34 samples had counts of <50,000 per g (the U.S.D.A. standard for Extra Grade non-fat-dry-milk) and six samples contained between 50,000 and 100,000 organisms per g which corresponds to the requirements for U.S.D.A. Standard Grade non-fat dry milk. Thirteen samples yielded plate counts in excess of 100,000 per g and two of these exceeded 1,000,000 per g.

In general, the lowest counts found, regardless of the type of organism, were associated with those dips containing cheese as the main flavoring ingredient. The highest counts were associated with dips flavored with onion, garlic or barbecue. The maximum standard plate count encountered in a base flavored with cheese was 100,000 per g, whereas the counts of those flavored with vegetables were frequently of much greater magnitude.

Eight of the 12 dehydrated bases flavored with cheese had coliform counts of <10 per g while the counts of those flavored with vegetables were usually much higher. Dehydrated vegetable bases probably contribute coliform organisms to the chip-dip. Slocum and Boyles *(6)* found *Escherichia coli* present on 31.5 per cent, and miscellaneous coliform organisms present on 78.3 per cent of 92 samples of fresh vegetables. They found a greater incidence of coliform organisms on vegetables grown below ground than those grown above ground. Clague *(2)* found more *E. coli* on carrots after dehydration than on the raw vegetable. He reported that the drying procedure alone was not enough to destroy *E. coli*, but that blanching before drying was effective in minimizing viable cells. The coliform counts of the ready-to-serve dips were all <10 per g. This is probably a function of the relatively low pH of these samples. In the sense that coliforms may indirectly represent a public health hazard, the populations encountered in some of the dehydrated bases are objectionable.

Long shelf-life is required in ready-to-serve dips because the rate of purchase and utilization by consumers is less predictable than for most dairy products. If high populations of psychrophiles are present, an undesirable combination of pH, temperature and time may result in spoilage; however, only four of the 59 samples examined contained >10 psychrophiles per g.

TABLE 2—FAT, MOISTURE, pH, PENETROMETER AND NITROGEN MEASUREMENTS ON DEHYDRATED, READY-TO-SERVE AND RECONSTITUTED CHIP-DIPS

	Product examined					
	34 samples of dehydrated bases		59 samples of ready-to-serve dips		56 samples of reconstituted dips	
Characteristic	Range	Number of samples	Range	Number of samples	Range	Number of samples
Fat (%)	0.4 to 10	13	13 to 20	34	3.0 to 10	12
	>10 to 20	8	>20 to 30	11	>10 to 20	33
	>20 to 30	7	>30 to 40	3	>20 to 29.5	11
	>30 to 34.3	6	40 to 54	11		
Moisture (%)	1.3 to 3.0	11	34.7 to 50	12	41.6 to 50	8
	>3.0 to 5.0	20	>50 to 60	3	>50 to 60	14
	>5.0 to 8.2	3	>60 to 70	14	>60 to 70	28
			>70 to 74.4	30	>70 to 78.9	6
pH			4.05 to 4.60	19	4.85 to 5.25	9
			>4.60 to 5.00	29	>5.25 to 5.75	32
			>5.00 to 5.65	11	>5.75 to 6.30	15
Body[a]			320 to 610	59	250 to 520	59
Nitrogen[b] (%)	1.31 to 7.25					

[a]Penetrometer reading $(\frac{mm}{10})$

[b]In the non-fat dry matter

As indicated in Table 1, the majority of the dehydrated bases and the ready-to-serve samples contained <10 yeasts per g. Two of the 34 dehydrated bases had yeast counts of 14,000 and 22,000, respectively. Four of the ready-to-serve dips had yeast counts in excess of 300,000 per g. The high yeast counts occurred in dips flavored with vegetables. This may have been due to contamination during processing rather than to the vegetables. Prescott (5) reported that mold spores were commonly present on dehydrated vegetables but yeasts were invariably absent.

Molds were more prevalent than yeasts in the dehydrated chip-dips. They occurred in greater numbers in the dips flavored with vegetables than in those flavored with cheese even including those flavored with blue cheese.

Chemical and physical analyses

The summarized data in Tables 2 and 3 show the extremes of values obtained with the various chemical and physical measurements on the three classes of chip-dips.

Fat content. Six of the dehydrated samples contained more than 30% fat and 13 contained less than 10%, of which three had less than 1% fat. The gross composition was known for 26 of the 34 samples of dehydrated base. Nine contained milk fat only, eight vegetable fat only and nine contained both milk fat and vegetable fat.

The ready-to-serve dips also contained both milk fat and vegetable fat. In general, the samples with the highest fat content were those containing vegetable fat. Ten samples contained vegetable fat as the sole fat source and in this group the amount of

TABLE 3—RANGE IN FAT, MOISTURE, pH AND PENETROMETER MEASUREMENTS ON CHIP-DIP BASES RECONSTITUED WITH VARIOUS DILUENTS

	Diluent						
Characteristic	Milk	Sour cream	Cream cheese	Creamed cottage cheese	Half and half	Whipping cream	Water
Fat (%)	6.7 -17.0	13.4 -19.6	13.0 -28.0	3.0 - 6.9	16.2	29.3 -29.5	7.3 -18.2
Moisture (%)	41.6 -67.7	59.1 -74.3	54.5 -67.7	58.0 -78.9	57.0 -58.3	45.5 -47.0	44.2 -48.0
pH	5.45- 6.30	4.84- 5.85	5.30- 6.05	5.35- 5.85	6.20- 6.25	5.15- 6.15	5.40- 5.80
Body[b]	250-406	291-453	290-420	330-520	326-346	286-300	255-385

[a]Two samples only

[b]Penetrometer reading $(\frac{mm}{10})$

fat ranged from 38.4 to 53.4%. Forty samples contained milk fat only with the amount ranging from 13.0 to 36.5%. Nine samples contained both types of fat with the total amounts ranging from 16.6 to 54.0%.

Moisture. The moisture content of the majority of the dehydrated samples was between 3.0 and 5.0%; however, 11 samples contained <3% and 3 samples contained >5% moisture. There was no apparant correlation between moisture content and microbial population. The range of per cent moisture in both the reconstituted and the ready-to-serve dips was about the same for both groups as indicated in Table 2. A greater difference was noted between groups reconstituted with the various diluents as indicated by the data summarized in Table 3. Obviously the composition of the reconstituted dips depended upon the composition of the diluent, the dehydrated base and the diluent-base ratio.

Rheology. The penetrometer values indicate the softness or plasticity of the dips. The ready-to-serve dips appeared to be softer than the reconstituted dips. Olson *et al (3)* observed that penetrometer values were closely related to scores on the body and spreadability of cheese spread. In the work reported herein little, if any, correlation existed between the penetrometer values and the body and texture scores which were determined subjectively. No significant relationship existed between the diluent used to reconstitute the dehydrated base and the penetrometer values obtained. This lack of correlation was attributed to differences in the nature of the components, particularly the stabilizers. Also, no correlation between penetrometer values and body and texture score could be demonstrated. This was attributed particularly to the fact that the body and texture score was subjective and reflected not only the plasticity of the dips, but also the visual observations and the physical and tactual effects of the product in the mouth.

pH. The pH of the reconstituted samples (Table 2) varied from 4.85 to 6.30 (average 5.54) whereas the ready-to-serve samples ranged from 4.05 to 5.65 (average 4.82). The latter group usually contained some food-grade organic acid.

Nitrogen. The total nitrogen in the non-fat dry matter, indicating the amount of protein and nitrogenous material in the dehydrated bases, varied from 1.31 to 7.35% (Table 2).

Organoleptic evaluation

Twenty-one of the 56 samples of reconstituted dips were criticized for flavor with stale powder occurring most frequently, followed by rancid, sour, bitter, excessive spice and chalky. Most of these flavor defects were attributed to the dehydrated bases which acquired off-flavor from several sources including oxidation, microbiological spoilage and blending of poor quality ingredients. Thirty-nine of the 56 reconstituted samples were criticized for body and texture defects, the most common of which were doughy, gummy, over-stabilized, coarse, mealy, por-

TABLE 4—COMPONENTS OF "READY-TO-SERVE" CHIP-DIPS AND DEHYDRATED CHIP-DIP BASES

	Ready-to-Serve	Dehydrated
Dairy Products		
Blue cheese	X[a]	X
Cheddar cheese	X	X
Cream	X	X
Milk	X	—[b]
Milk fat	X	—
Milk protein	—	X
Neufchatel cheese	X	—
Nonfat dry milk	X	X
Parmesan cheese	—	X
Swiss cheese	—	X
Whey, dried	—	X
Vegetables		
Carrot	—	X
Dill pickle	X	—
Garlic	X	X
Horse radish	X	X
Mixed vegetables	X	—
Olive	X	X
Onion	X	X
Parsley	X	X
Pepper	X	X
Pimento	X	—
Tomato	X	—
Miscellaneous		
Bacon	X	—
Egg yolk	X	—
Monoglutamate	X	X
Onion soup	X	—
Soybean flour	—	X
Starch	—	X
Vegetable fat	X	X
Vegetable protein	X	X
Yeast, smoked	X	X
Citric acid	—	X
Lactic acid	—	X
Lemon juice	X	—
Vinegar	X	—
Calcium stearate	—	X
Disodium phosphate	—	X
Sodium citrate	—	X
Sodium silica aluminate	—	X
Stabilizer	X	X
Color	X	X
Preservative	X	—
Salt	X	X
Spice	X	X
Sugar	X	X
Water	X	X

[a]Ingredient present
[b]Ingredient not present

ous or spongy.

Generally the ready-to-serve dips were assigned higher hedonic scores than the reconstituted dips on the basis of flavor, body and texture. Only 12 of the 59 ready-to-serve samples were criticized for flavor defects. Usually the criticism was stale ingredients. Twenty of these samples were criticized for body and texture defects with weakness being the most common criticism.

Components

The components of the commercial dehydrated chip-dip bases and the ready-to-serve chip-dips are indicated in Table 4. Tabulations were made from the information provided on the label of the various products. Obviously not all of the constituents listed are to be found in any one base or dip.

SUMMARY AND CONCLUSION

Dehydrated chip-dip bases and ready-to-serve chip-dips were examined chemically and microbiologically. Additional appropriate tests for physical and chemical properties were applied to the above types of dips and to reconstituted dips.

Chip-dips flavored with vegetables or spices usually had much higher total, coliform and mold counts than samples flavored with cheese. The fat content of dehydrated chip-dips varied from 0.4 to 34.3%, whereas the fat content of the ready-to-serve samples varied from 13.0 to 54.0%. Both groups included samples which contained *(a)* milk fat only, *(b)* vegetable fat only and *(c)* blends of both fats.

The moisture content of the dehydrated bases varied from 1.3 to 8.2% and in the ready-to-serve samples the variation ranged from 34.7 to 74.4%. The ready-to-serve chip-dips were more acceptable organoleptically than those reconstituted from dehydrated bases.

The high populations of organisms in some of the samples of chip-dips and the variations in composition indicate that consideration should be given to the establishment of regulatory standards.

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ROLE OF SANITATION IN DEHYDRATION OF FOODS[1,2]

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This is an age of movement. From week-end picnics to outer space we are a nation on the move. This concept of movement has also become a part of the doctrine of military planning and make up. In order to move fast and far one must be properly equipped and unburdened with weighty and bulky materials. Since food is an important part of the supplies of men in the Armed Forces, it has become necessary to pay considerable attention to the make up, form and weight of this food.

Over the years food has been processed in cans and has proven very satisfactory with regard to stability, utility and handling. This is still true, and canned foods offer no problems where large numbers of men are in training or fairly stationary. However, for the striking force of rapidly moving men believed necessary for any future action such types of food supplies present a problem. Food in round cans is difficult to carry on the person; it is heavy and bulky and does not fit into the weight

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[2]This paper reports research undertaken at the QM Food and Container Institute for the Armed Forces, QM Research and Engineering Command, U. S. Army and has been assigned No. 2165 in the series of papers approved for publication. The views or conclusions contained in it are those of the author. They are not to be construed as necessarily reflecting the views or indorsement of the Department of Defense.