Evidence indicates that

A PREMIX OF FPC & WHEAT FLOUR CAN BE MADE & TRANSPORTED

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The authors conducted a study to determine if mixtures of wheat flour and fish protein concentrate (FPC) would tend to separate during the agitation of a mechanical shaker. Mixtures of 90% wheat flour and 10% FPC were placed on a shaker for 168 hours. Despite differences in particle size between the wheat flour and the FPCs, there was no evidence of separation.

FPC is intended to be used as a protein ingredient in foods. It has been used successfully in a variety of baked products (Sidwell, et al., 1970). When used in products based on wheat flour, FPC either could be added directly to the other ingredients--or an FPC-wheat flour premix could be prepared and used later in the products. The premix would be advantageous because it could be prepared easily in bulk at large industrial centers. It could then be shipped and distributed to food-processing plants in this country or in foreign countries.

Wheat flour and FPC particles, however, may differ in size and other characteristics. Because of these differences, separation might occur during shipment and result in a non-uniform premix. The purpose of our experiment, therefore, was to determine if mixtures of wheat flour and FPC separated when subjected to continuous agitation.

MATERIALS AND METHODS

The wheat flour used was a patent, bromated, enriched bread flour obtained from the Pillsbury Company, Minneapolis, Minnesota.

The FPC was prepared by isopropyl alcohol extraction of red hake (Urophycis chuss) (Bureau of Commercial Fisheries, 1966). Two FPC samples were used that had been ground in different mills to produce material with different particle sizes. One sample was milled in a Rietz disintegrator1/ and was relatively coarse; the second sample was milled in a fluid energy mill and was relatively fine.

The wheat flour and the two FPC samples were analyzed for crude protein by the method described in Section 2.044 of the AOAC Methods of Analysis (1965). The moisture content was analyzed by drying the samples in a forced-air oven for 16 hours at 100° C. Ash was determined by burning the samples in a muffle furnace for 16 hours at 550° C.

The particle size distribution of the samples was determined with a Ro-Top Testing Sieve Shaker. This consisted of a series of four U.S. Bureau of Standard Sieves, which had the following pore sizes: 149, 105, 44, and 37 microns. One hundred-g samples were placed on the top sieve and the shaker was run continuously for 30 minutes. The material remaining on each sieve was then weighed separately.

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1/Trade names are used merely to facilitate descriptions; no endorsement is implied.

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The bulk density of the wheat flour and FPC samples was determined also. Each sample was carefully poured into a 25-ml graduated cylinder with a n opening of 1 cm. The sample was removed and weighed. The bulk density was calculated by dividing the 25-ml volumes into the weight of the sample.

Two wheat flour-FPC mixtures were prepared: one contained the coarsely ground FPC, the other the finely ground FPC. Each mixture weighed 2 kg, and each contained 90% wheat flour and 10% FPC. Two wide-mouth, 1-gallon glass bottles were lined with polyethylene bags. The wheat flour-FPC mixtures were transferred loosely to the bags, which were then tied. There was a small head space at the top of the containers. The tops were placed on the glass jars and they were placed on an Eberbach mechanical shaker operating at 60 oscillations per minute. The samples were allowed to shake back and forth continuously for 168 hours.

At the end of this period the mixtures had settled and there was approximately a 2-inch head space in the jars. The jars were scored with a glass cutter and carefully cracked open, so as not to disturb their contents. The polyethylene bags were cut lengthwise. Two random samples were taken from each of the top, middle, and bottom portions of the mixtures. To determine if separation had occurred during shaking, these samples were analyzed for protein, moisture, and ash by the methods previously described.

RESULTS AND DISCUSSION

Table 1 shows the particle size distribution in the two samples of FPC and the sample of wheat flour. The Rietz-milled FPC and the wheat flour were somewhat similar in particle size distribution. The fluid energy-milled FPC, however, was considerably finer than the other two samples. This FPC was not gritty in texture, whereas the Rietz-milled FPC had a definite gritty texture.

Table 2 shows the protein and ash contents and the bulk densities of the wheat flour and FPC samples. It is evident that there was a considerable differential between the wheat flour and the FPCs in their contents of protein and ash. Also, the bulk density of the wheat flour was slightly higher than that of the FPCs.

Table 1 - Particle size distribution of wheat flour and FPC (fish protein concentrate) samples[a]

Sieve opening	Sieve No.[b]	Percent by weight of samples held by each screen: Wheat flour	FPC: Rietz-milled	FPC: Fluid-energy milled
μ		%	%	%
149	100	0.0	0.5	0.0
105	140	12.3	14.3	0.5
44	325	68.3	44.8	0.6
37	400	16.8	9.0	30.2
<37	-	2.8	30.6	68.2

[a] Values are expressed as percent of the sample retained on indicated screen. Values for <37 μ are percentages of samples that passed through screen with openings 37 μ in size.
[b] Indicates approximate number of openings per lineal inch for U. S. Bureau of Standards Standard Screen Series.

Table 2 - Protein and ash contents and bulk densities of wheat flour and of FPC (fish protein concentrate) samples[a]

Samples analyzed	Composition of samples: Crude protein[b]	Ash	Bulk density
	%	%	
Wheat flour	11.8	0.47	0.535
FPC:			
Rietz-milled	87.7	13.1	0.488
Fluid energy-milled	87.6	11.5	0.450

[a] Values are expressed on a moisture-free basis.
[b] Nitrogen x 6.25.

Table 3 shows the protein and ash composition of the mixtures of wheat flour and FPC before and after shaking. After 168 hours of continuous shaking, the protein and ash contents of the mixtures at the three locations were nearly identical. These values were also nearly identical to those for the whole mixtures before shaking. These results show that no significant separation occurred in the mixtures during shaking.

The results from this study indicate that mixtures of wheat flour and FPC do not tend to separate during agitation. Although confirmation of these results under practical conditions is needed, they indicate that a premix of wheat flour and FPC could be prepared and transported without separation occurring.

Table 3 - Protein and ash contents of wheat flour and FPC (fish protein concentrate) mixtures before and after shaking for 168 hours[a]

Time and location of sampling	Composition of mixtures: Wheat flour 10% Rietz-milled FPC		Wheat flour 10% fluid energy-milled FPC	
	Crude protein[b]	Ash	Crude protein[b]	Ash
	%	%	%	%
Before shaking:				
Whole mixture	20.0	1.84	20.1	1.58
After shaking:				
Top of mixture	20.3	1.79	20.5	1.57
Middle of mixture	20.0	1.79	20.4	1.57
Bottom of mixture	20.1	1.77	20.4	1.57

[a] Values are expressed on a moisture-free basis. Each value is an average of duplicate analyses on each of two samples taken from each location.

[b] Nitrogen x 6.25.

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