The Use of Whole Cow Peas in Processed Food Products

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Summary

Legumes such as cowpeas (Vigna sinensis) are important sources of protein and other nutrients in the diets of people throughout the world. They are usually prepared for consumption by boiling the whole, mature seeds in water. Expanding the use of cowpeas to include their incorporation as a significant ingredient in processed foods has considerable potential to economically increase dietary protein in many situations. This research was designed to develop new food product formulations from whole cowpeas. Highly acceptable food products were developed from either mild alkali-treated or dry-roasted cowpea "flours". These foods included a chocolated-flavored pudding, cowpea "butter", cookies, frozen desserts and bread from wheat/cowpea blends. The use of comparatively simple, inexpensive processing and formulation procedures was a major consideration in the current work.

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Introduction

While cowpeas are not currently a significant crop in Arizona, they are grown extensively in California, Southern U.S.A., Asia, Latin America and Africa. The current research represents some original work which can be used as a model and applied to many kinds of legume seeds intended for human consumption. In preparation for food formulation applications, cowpea materials involving several possible treatments are of interest. These are designed to reduce or change the typical "beany" flavor and to improve other functional properties of the legume solids. Mild alkali treatment, for example, drastically reduces or changes the typical "beany" flavor of cowpeas. Dry-roasting also changes their original flavor characteristic.

Results And Discussion

Chocolate-flavored Pudding

This product had a typical pudding consistency, very mild odor, chocolate brown color and pleasant flavor. It was stored for up to 3 months without significant changes in the original characteristics. It had 3.5% protein and other important nutrients. The processing procedure is shown in Figure 1.

Cowpea "Butter"

A suitable tempterature/time of dry-roasting produces a nut-like flavor in cowpeas. The dry-roasted (180°C/50 min.), pulverized cowpeas are then mixed with vegetable oil and flavoring to simulate peanut butter composition and properties. The basic procedure is:

1. Melt coconut fat at 40°C.
2. Add Wesson oil, cowpeas, salt and dextrose to the melted coconut fat.
3. Blend in mechanical mixer for 3 minutes.
4. Package and cool.

The product had a very acceptable appearance, spreadability, flavor and 16% protein. The formula is shown (Table 1).

Table 1. Cowpea "Butter" Formula

Ingredient	(%)	Common Units
Pulverized, dry-roasted, whole cowpeas	61.0	3 c
Wesson vegetable oil	23.1	1 c
Coconut fat	9.9	½ c
Dextrose	5.0	¼ c
Salt	1.0	1 tsp.
Total	100.00	

Cowpea "Butter" Scotch Bars

This pastry dessert which was formulated from the previously described cowpea "butter" was very acceptable. The procedure is:

1. Blend margarine and cowpea "butter" at medium speed for 5 minutes.
2. Add brown sugar gradually and blend for an additional 10-15 minutes, scraping down the sides and bottom of bowl every 5 minutes.
3. Add vanilla and mix. Add flour, baking powder, and salt and mix completely.
4. Add chocolate morsels and mix again at low speed until evenly mixed.
5. Place into a 20 x 20 cm pan and evenly distribute over the bottom of the pan. Bake in a 190°C oven for 25 minutes. While still warm, cut into 5 x 4 cm squares.

The formula is also given (Table 2).

1.	Blackeyed peas	Clean to remove non-legume, extraneous material
2.	Soak	Overnight in tap water solution of 0.5% $NaHCO_3$ (1:3::pea:solution) at room temperature
3.	Drain, rinse	Drain and rinse in room temperature tap water
4.	Blanch	In fresh tap water solution of 0.5% $NaHCO_3$ for 30 minutes (1:3::original dry peas:solution)
5.	Drain, rinse	Drain and rinse in room temperature tap water
6.	Slurry blending	Blend in a Waring blender at high speed, adding tap water to make about 12% solids (room temperature)
7.	Heat	Heat the slurry to 92°C in a water bath, stirring constantly
8.	Homogenize	At 175 kg/cm^2 (first stage pressure) and 35 kg/cm^2 (second stage pressure)
9.	Neutralize	With 6 N HCl to pH 6.8
10.	Formulate	12% cowpea solids, 10% sucrose, 3.5% coconut fat, 1.5% cocoa, 0.3% emulsifier/stabilizer, diacetyl and vanilla flavoring (According to manufacturer's recommendations)
11.	Heat	82°C
12.	Cool	60°C
13.	Homogenize	As in step 8
14.	Pack	Clear glass 170 ml containers
15.	Cool and store	4°C

Figure 1. Formulation and Processing Procedure for Chocolate-flavored Pudding from Whole Cowpeas.

Table 2. Cowpea "Butter"Scotch Bars Formula

Ingredient	Common Units
Cowpea "butter"	1½ c
All-purpose flour	1½ c
Light brown sugar	1½ c
Chocolate morsels (semi-sweet)	½ c
Soft margarine	3/4 c
Baking powder	½ tsp
Salt	¼ tsp
Vanilla extract	5 drops

Cowpea-based Frozen Dessert

The frozen dessert formulation was based on cowpea flour, coconut fat, sugar, whey protein isolate, stabilizer/emulsifier and flavors (Table 3). The procedure for making the dessert is as follows:

1. Follow the procedure for cowpea pudding up to blending (Figure 1, step 6).
2. Add cocoa and mix well.
3. Heat the slurry to 74°C for 30 minutes.
4. Cool to 60°C and homogenize the mixture as in chocolate pudding.
5. Cool to 4°C.
6. Freeze with continuous freezer.
7. Package and harden.

Heating the slurry to 74°C is critical to avoid further gelatinization, which is undesirable for the next steps. It was important to add cinnamon just before homogenization to partially prevent the volantinization of its aroma. The product had acceptable flavor and good appearance.

Table 3. Chocolate, Cinnamon-flavored Cowpea Frozen Dessert Formula

	Weight (g)	Total (%)
Water	23,000	58.0
Sucrose	6,000	15.0
Cowpea solids	4,400	11.0
Coconut fat	4,000	10.0
Cocoa	1,600	4.0
Whey protein	400	1.0
Cinnamon powder	200	.5
Emulsifier	160	.4
Stabilizer	40	.1
Total	40,000	100.0

This dessert had 4% protein which is significantly higher than that in most ice cream products.

Bread Made from Wheat Flour/Cowpea Blends

Foods supply a provisional pattern of essential amino acids which is dependent on the amino acid balance of the various proteins in the respective materials eaten together. For example legumes are a relatively poor source of methionine and cysteine while cereals are generally adequate in those amino acids. The opposite is true for lysine. Blends of cereals and legumes, therefore, offer the possibility of complementary essential amino acid sources. Pastries are a generic class of foods which provide a highly logical opportunity for cereal/legume formulation blends. This work compared blends of wheat flour and pulverized, dry-roasted whole cowpeas in bread formulations.

The following blends were evaluated:

All-purpose or Whole Wheat Flour	Cowpeas
----------%----------	
100	0
75	25
65	35

A standard, home-type bread formula was used (Table 4).

Table 4. Bread Formula

Ingredient	(%)	Common Units
Wheat flour: cowpea blend	54.0	2½ c
Water	35.0	1 c
Shortening	4.9	1 1/3 c
Sugar	1.7	1¼ T
Dry whey	1.6	1¼ T
Yeast	1.6	1¼ T
Salt	1.2	2 t

Minor modifications were involved in the respective 75:25 and 63:35 combinations.

Measurements and observations were made on loaf volume, texture, color, flavor, odor and protein. Loaf volume of bread from the 75:25 all-purpose flour: cowpea blend was identical to its control (3.8 Cm^3/g) (Table 5). Both the 65:35 formulations as well as the 75:25 whole wheat product had somewhat lower but similar loaf volumes (3.0 or 3.1 Cm^3/g). While all of the values are below those usually found in domestic, commercially-produced products, they are well within the range seen in home-type bread. Should higher loaf volumes be desired, the use of commercial formulations and technology would be effective.

Table 5. Loaf Volumes of Wheat Flour: Whole Cowpea Breads

Blend	All-purpose Flour		Whole Wheat Flour	
	(Cm^3/g)	(% of control)	(Cm^3/g)	(% of control)
Control	3.8	100	3.9	100
75:25	3.8	100	3.1	79
65:35	3.0	79	3.1	79

Texture, color, flavor and odor of all 75:25 products as well as those of the 65:35 whole wheat combination were satisfactory (Table 6). Those properties of the 65:35 all-purpose wheat flour product were slightly less typical as compared to the control.

Table 6. Texture, Color, Flavor and Odor of Wheat Flour:

Whole Cowpea Breads.

Blend	All-purpose Flour			Whole Wheat Flour		
	Texture	Color	Flavor, Odor	Texture	Color	Flavor, Odor
Control	Normal	Normal	Normal	Normal	Normal	Normal
75:25	Normal	Sl.drk.	Sl. beany	Normal	Normal	Normal
65:35	Sl.Hvy.	Very drk.	Strong beany	Sl.hvy.	Normal	Sl. beany

The percent protein in the wheat flour: cowpeas blends was significantly higher than that in the control product (Table 7).

Table 7. Percent Protein in Wheat Flour: Cowpea Blends

	Control	75:25	65:35
All-purpose Flour	11.0	13.8	15.9
Whole Wheat Flour	13.0	15.3	17.2

Protein Efficiency Ratio (PER) of Whole Cowpea Materials

PER is a measurement of the biological value of proteins. Since mild alkali-treatment or dry-roasting may change food proteins, PER of the cowpea materials was determined. Casein (milk protein) was used as a comparison standard. In order to observe the possible effect of mild alkali soaking, a cowpea product was included in which the soaking treatment involved tap water only. Fortification with amino acids---methionine, threonine and lysine---was also included (Table 8).

Table 8. PER of Cowpea Materials after Mild Alkali-treatment and Dry-roasting.

Material	PER
Casein	2.8
Tap water-soaked cowpeas	2.4
Mild alkali-soaked cowpeas	1.6
Alkali-soaked cowpeas + 0.36% methionine	3.3
Alkali soaked cowpeas + 36% methionine and 0.06% threonine	3.5
Dry-roasted cowpeas	2.2
Roasted cowpeas + 0.36% methionine	3.0
Roasted cowpeas + 0.36% methionine + 0.06% threonine	3.4
Roasted cowpeas + 0.36% methionine + 0.06% threonine, + 0.10% lysine	3.5

These values indicate that mild alkali treatment reduces the PER of whole cowpeas but dry-roasting does not. Methionine fortification at 0.36% raises the PER value of both products to a level somewhat greater then either the water-soaked cowpeas or the casein standard.

CONCLUSIONS

This work has demonstrated that highly acceptable food products of several types can be formulated with either mild alkali-treated or dry-roasted whole cowpeas. The foods have significantly higher protein contents than ones of conventional ingredient array. Comparatively simple, inexpensive procedures were used. The list of foods using similarly processed whole cowpeas can be exteneded to include items such as yogurt-type fermented products, snack foods, prepared breakfast cereal-type foods, flavored beverages and packaged cowpea solids for household use.