Development of Yellow Sweet Potato and Red Kidney Bean-based Instant Cream Soup for Pregnant Mothers with Chronic Energy Deficiency

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ABSTRACT

This study aimed to develop an instant cream soup formula composed of yellow sweet potato and red kidney bean for maternal chronic energy deficiency. The selected formula is acceptable based on organoleptic test. In addition, the food formula is expected to meet nutritional needs, including protein, fat, carbohydrate, energy, and vitamin A. Amino acid score and in vitro protein digestibility were also measured to verify whether or not the product of the formulation has high protein quality. The instant cream soup was composed of yellow sweet potato and red kidney bean. Additional ingredients that were added to increase the nutritional value and sensory attributes of the instant cream soup included soy protein isolate, egg white flour, maltodextrin, red palm oil, onion, garlic, leek, celery, chicken broth, fresh cream (cooking cream), black pepper, and salt). This experimental study used a randomized factorial design in laboratory. The treatment unit included two factors: provision of yellow sweet potato and red kidney bean consisting of three levels (50%:50%, 75%:25%, and 25%:75%) and addition of maltodextrin consisting of two levels (0% and 5%). Hedonic organoleptic analysis showed that the selected formula comprised 75%:25% yellow sweet potato and red kidney bean and 5% maltodextrin addition (F5). Nutrient content analysis revealed that the product contained 3.85% moisture, 3.15% ash, 30.19% protein, 14.18% fat, 48.63% carbohydrate, 443 kcal energy, 17.67% dietary fiber, 87 ppm β-carotene, and 77.21% protein digestibility. This study also showed that methionine and cysteine were the limiting amino acids in the selected product with a score of 47%. Acceptability from 100 pregnant women was assessed, and results showed that 87% of pregnant women accepted the product. These results indicate that this product has the potential to be an alternative snack for maternal chronic energy deficiency because of its nutritional values.

Keywords: chronic energy deficiency; instant cream soup; pregnancy; red kidney bean; yellow sweet potato

INTRODUCTION

Chronic energy deficiency (CED) is an important manifestation of malnutrition, which is a major problem in developing countries. The prevalence of CED in pregnancy was 24.2% in 2013 (Kemenkes, 2013) and 17.3% in 2018 (Ministry of Health RI, 2019). Although the prevalence level has decreased over time, data obtained from nutritional status monitoring showed that 53.9% of pregnant women still experience energy deficiency and 51.9% still suffer protein deficiency (Ministry of Health RI, 2019). In addition, the prevalence of 17.3% in 2018 is still categorized as a nutritional problem in pregnancy because it is higher than 5% (WHO, 2010).

CED interferes with fetus growth during pregnancy. It contributes to 800 000 neonatal death, 400 000 fetus deaths, and 20% of stunting in children aging within the first 2 years of life (Black *et al*., 2008). CED in pregnancy may cause risks and complications for the expectant mothers, including but not limited to maternal weight not increasing normally, anemia, hemorrhage, and exposure to infectious diseases. Meanwhile, the effects of CED on laboring include premature birth, stillbirth, and low birth weight (Patel *et al*., 2018). CED may also affect fetus growth and cause miscarriage, abortion, anemia in children, congenital defect, and neonatal death (Obai *et al*., 2016).

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Intervention strategies that can be conducted to overcome CED in pregnancy is through food intervention. Food intervention is the best way considering its ease and cost effectiveness. A form of food intervention that can be proposed is supplementary food for pregnant women. Types of food supplementation could range from local or mass-produced foods. Supplementary food can be made to contain high-energy protein or balanced-energy protein. A meta-analysis showed that the provision of a balanced-energy protein supplementary feeding/snack (energy: 300–800 kcal/day; protein: <25% of total energy) could increase maternal body weight, notably in pregnant women with CED, increased fetus growth and baby size (Prihanantono *et al*., 2006). A possible supplementary food is instant cream soup made from yellow sweet potato and red kidney bean.

Compared with other forms of food product, instant cream soup maintains stable flavor for about 6–12 months, has longer shelf-life and lighter weight, is easier to prepare, preferable in modern society, and cheaper (Dhiman *et al*., 2017). The development of instant cream soup based on yellow sweet potato and red kidney bean is appropriate because it can increase the potential of local food utilization and varies in nutrients.

Yellow sweet potato is an alternative source of energy and carbohydrates that can substitute rice, containing nutrients equal to rice and grain. It contains protein, fat, vitamins, and minerals (Neela & Fanta, 2019). In addition, it contains beta-carotene compounds that are needed by pregnant women to maintain immunity and healthy bones, teeth, skin and hair. Beta-carotene could increase hemoglobin level as much as 0.2–1.0 g/dL during 2 weeks in pregnant women (Randhika *et al*., 2002). Pregnant women with CED are at four times the risk of developing anemia (OR:4,082) (Lubis *et al*.,). For the fetus, it is needed for the nervous system, cell membrane, and vision (Ginting *et al*., 2006). Red kidney bean is a source of protein that is widely consumed worldwide, including Indonesia. Red kidney bean is also another source of nutrients, such as fat (15.80%), dietary fiber (3.60%), and several important/essential minerals, including iron (Audu & Aremu, 2011).

This study aimed to develop an instant cream soup formula composed of yellow sweet potato and red kidney bean that is acceptable based on organoleptic test. The food formula is expected to meet nutritional needs, including protein, fat, carbohydrate, energy, and vitamin A. The amino acid score and in vitro protein digestibility are also evaluated to determine protein quality.

METHODS

Design, Place, and Time

This experimental study used a randomized factorial design in laboratory. Instant cream soup was made in Food Processing and Experiments Laboratory, Department of Community Nutrition, IPB University. The powder formation of cream soup was carried out in the Southeast Asian Food and Agricultural Science Center (SEAFAST), IPB University. A sensory evaluation test was carried out in the Organoleptic Laboratory, Department of Community Nutrition, IPB University. Contents of moisture, ash, protein, fat, carbohydrate, energy, dietary fiber, and in vitro protein digestibility were measured in the Laboratory of Chemistry and Food Analysis, Department of Community Nutrition, IPB University. Beta-carotene amount was analyzed in Balai Besar Industri Agro, Bogor City. Amino acid content was carried out in the Integrated Laboratory, Bogor City. Product acceptability of 100 pregnant women was surveyed in several Maternal and Child Health Center (Posyandu), Bogor City. This study was conducted from October 2018 until June 2019.

Materials and Tools

Instant cream soup was produced using main and additional materials or ingredients. The main ingredients were yellow sweet potato and red kidney bean. The additional ingredients were soy protein isolate (SPI), egg white flour, maltodextrin, red palm oil (RPO), onion, garlic, leek, celery, chicken broth, fresh cream (cooking cream), black pepper, and salt. Chemical materials used in this study included the following: 1) Protein analysis: 30% NaOH, H_3BO_3, H_2SO_4, 95% HCl, selenium mix, methyl red indicator and methylene blue indicator; 2) fat analysis: hexane solvent; 3) dietary fiber analysis: 0.08 M phosphate buffer (pH 6), Termamyl, 0.275 N NaOH, protease, 0.325 N HCl, AMG, 95% ethanol, 78% ethanol, and acetone; 4) beta-carotene analysis: standard solution of beta-carotene, Aqua Bidest, ascorbic acid, 95% ethanol, 100% KOH, Na–sulfate, and hexane; 5) protein digestibility analysis: 0.5 N NaOH, 0.2 M phosphate buffer solution (pH 8), 0.1 N HCl, K_2SO_4, HgO, H_2SO_4, distilled water, $NaS_2O_3.5H_2O$, H_3BO_3, red indicator, and 0.02 N HCl; and 6) amino acid analysis: 6 N HCl, derivatization solution, acetonitrile, and 1 M sodium acetate buffer.

Equipment used to prepare instant cream soup included stove, knife, cutting board, cooking pan, blender, wooden spatula, food scale, and bowl. Drum dryer (Zhengan, Dehumidifier, Jiangsu China), Sic mill, sealer, stainless container, and big/baking pan were used to pulverize the instant cream soup. Tools utilized

in nutrient content analysis included aluminium cup, oven (Memmert, UN 55 53 L, Germany), desiccator, analytical scale, micro pipette, porcelain cup, furnace, tweezers, clamp, Soxhlet system (Foss, ST-243 Soxtec, Denmark), Kjeldahl flask (Foss, Digestor 2508, Denmark), distillation tools (Foss, KT-200 Kjeltec, Denmark), Erlenmeyer flask, water bath (Memmert, WNB 7, Germany), measuring cup, burette, pipette, filter paper, spectrophotometer (Hitachi, AAS Z-8230, Japan), evaporator, HPLC equipment (Shimadzu, HPLC LC-20 AD, Japan), water bath shaker (Memmert, WNB 7, Germany), pH meter, rotary evaporator, and test tube.

Research stages

This study was initiated by instant cream soup formulation and production. The organoleptic test was performed to select the best formula. The selected formula was further analyzed to identify the nutrient content, total dietary fiber, beta-carotene, amino acid score, and in vitro protein digestibility.

Ingredient formulation and production of the instant cream soup were conducted in two phases. The first phase was determining the ratio of yellow sweet potato to red kidney bean as the first factor and addition of maltodextrin as the second factor. The second phase was calculating the minimal nutrient content in accordance with SNI 01-4967-1999 and technical guidelines of supplementary food for expectant mothers with CED (Kemenkes, 2017). Formula determination was also performed through trial and error. The levels of the first factor were 1:1, 3:1, and 1:3. Meanwhile, the levels of the second factor were 0% and 5%.

The initial stage of making instant cream soup was preparation using raw materials (yellow sweet potato and red kidney bean) and additional ingredients (egg white flour, soy protein isolates, RPO, maltodextrin, fresh cream, chicken, carrots, black pepper, onions, garlic, leeks, celery, and salt). All raw materials and additional materials were weighed according to the specified formula. Sliced garlic, onions, leeks, and carrots were sautéed in RPO. Then, chicken broth was added together with yellow sweet potato, red kidney bean, celery, salt, and black pepper. After boiling, the cream soup was allowed to stand until cool. Then, egg white flour and SPI were added. In the next step, all ingredients were blended using a blender. All the ingredients were reheated until they thickend. The stove was turned off, and fresh cream was added.

Drying with a drum dryer was then performed to obtain cream soup powder. All cream soup formulas were added with maltodextrin (in levels of either 0% and 5% according to each formulation) before drying with a drum dryer to improve texture (viscosity) and increase product yield. Finally, cream soup powder was rehydrated using warm water. Exactly 100 g of cream powder was cooked in 400 mL of water at 100°C for 3–5 min. The formulation of instant cream soup is displayed in Table 1 (for 3 serving sizes, 40 g/serving size).

Analysis of organoleptic

The instant cream soup was subjected to an organoleptic test to determine the best among the six formulations. Setyaningsih and Apriyantono (2010) stated that the hedonic test is performed to determine

Table 1. Formulation of instant cream soup composed of yellow sweet potato and red kidney bean for maternal chronic energy deficiency

Materials/ingredients	Unit	F1	F2	F3	F4	F5	F6
Yellow sweet potato	g	50	75	25	50	75	25
Red kidney bean	g	50	25	75	50	25	75
Maltodextrin	g	0	0	0	26	26	26
Egg white flour	g	6	6	6	6	6	6
Fresh cream	g	30	30	30	30	30	30
Soy protein isolate	g	18	18	18	18	18	18
Red palm oil	g	10	10	10	10	10	10
Chicken broth	mL	300	300	300	300	300	300
Chicken	g	10	10	10	10	10	10
Carrot	g	10	10	10	10	10	10
Black pepper	g	2	2	2	2	2	2
Onion	g	10	10	10	10	10	10
Garlic	g	6	6	6	6	6	6
Leek	g	10	10	10	10	10	10
Celery	g	6	6	6	6	6	6
Salt	g	2	2	2	2	2	2

the panelist's preference of food product properties. The organoleptic test was performed on 30 semi-trained panelists, including students of the Department of Community Nutrition, Faculty of Human Ecology, IPB University. The organoleptic properties of the instant cream soup were analyzed using a 7-point hybrid hedonic scale. The parameters of the hedonic test of the instant cream soup were color, smell, taste, texture, mouthfeel, aftertaste, and overall properties. The scales used in these parameters were as follows: (1) dislike very much/extremely, (2) dislike moderately, (3) dislike slightly, (4) neither dislike or like, (5) Like slightly, (6) Like moderately, and (7) like very much. Values greater than 3 indicated that the panelists accepted the product sample. The six formulations of instant cream soup are as follows: F1 (50%:50% yellow sweet potato and red kidney bean and 0% maltodextrin), F2 (75%:25% yellow sweet potato and red kidney bean and 0% maltodextrin), F3 (25%:75% yellow sweet potato and red kidney bean and 0% maltodextrin), F4 (50%:50% yellow sweet potato and red kidney bean and 5% maltodextrin), F5 (75%:25%yellow sweet potato and red kidney bean and 5% maltodextrin), and F6 (25%:75% yellow sweet potato and red kidney bean and 5% maltodextrin. The selected formula was determined based on the highest mean value in each organoleptic property.

Analysis of Selected Instant Cream Soup

Proximate analysis (moisture content, ash, protein, fat, and dietary fiber) was performed in accordance with AOAC, (2005). The carbohydrate content was calculated by difference. Energy content was calculated by counting energy contribution from protein, carbohydrate, and fat. In vitro protein digestibility was analyzed as previously described (Saunders *et al*., 1973). Protein digestion was investigated by reacting samples with the pepsin and trypsin. The principle of the measurement is that the protein sample is hydrolyzed by an enzyme mixture to amino acids, and then the hydrolysis process releases hydrogen ions, causing a decrease in pH. Beta-carotene and amino acid content were calculated in accordance with AOAC (2000). All nutrient contents had to meet SNI 01-4967-1999 about instant cream soup (SNI, 1999) and technical guidelines of supplementary food for pregnant mothers with CED (Kemenkes, 2017). Product acceptability of 100 pregnant women was determined using a hedonic organoleptic test (same as organoleptic analysis). This research has approved by the Human Research Ethics Committee of the IPB University with number 129/IT3.KEPMSM-IPB/SK/2018.

Data Analysis

Descriptive statistics and one-way ANOVA were performed to analyze the data regarding organoleptic properties. Nutritional contents (water, ash, protein, fat, carbohydrate, energy, dietary fiber, beta-carotene), amino acid score, protein digestibility, and product acceptability were tabulated and analyzed descriptively. Data were processed using 2013 Microsoft Excels and SPSS version 22 for Windows.

RESULTS AND DISCUSSION

The hedonic (preference) test was the organoleptic test used in this study. The atributes considered in the hedonic test were color, smell, taste, texture, mouthfeel, aftertaste, and overall properties. The data of organoleptic test are presented in Table 2. The mean values of panelist preference for all attributes, except color, of the products were significantly different in the organoleptic test ($p < 0.05$).

The ratio of yellow sweet potato and red kidney bean and the level of maltodextrin exerted significant effects on the color, texture, taste, mouthfeel, aftertaste, and overall properties of instant cream soup. ANOVA test results showed that F5 was not significantly

Table 2. Panelists mean hedonic scales of organoleptic properties of instant cream soup composed of yellow sweet potato and red kidney bean

Formulation	Organoleptic properties						
	Color	Smell	Texture	Taste	Mouthfeel	Aftertaste	Overall
F1	3.77 ± 1.43^{c}	4.73 ± 1.30^{a}	4.12 ± 1.11^{d}	4.48 ± 1.31^{b}	4.22 ± 1.40^{c}	4.37 ± 1.29^{c}	4.40 ± 1.32^{c}
F2	4.67 ± 1.55^{ab}	5.20 ± 1.04^{a}	4.30 ± 1.61^{cd}	5.15 ± 1.27^{ab}	4.48 ± 1.40^{bc}	4.97 ± 1.21^{ab}	4.88 ± 1.22^{b}
F3	4.60 ± 1.15^{ab}	4.88 ± 1.11^{a}	4.48 ± 1.40^{bcd}	4.68 ± 1.40^{b}	4.37 ± 1.16^{b}	4.63 ± 1.22^{bc}	4.73 ± 1.20^{bc}
F4	4.58 ± 1.14^{ab}	4.85 ± 1.01^{a}	4.95 ± 1.27^{ab}	4.83 ± 1.22^{b}	4.87 ± 1.14^{ab}	4.90 ± 0.99^{ab}	4.98 ± 1.03^{ab}
F5	5.10 ± 1.42^{a}	5.05 ± 1.20^{a}	5.08 ± 1.27^{a}	6.15 ± 6.66^{a}	5.07 ± 1.20^{a}	5.13 ± 1.19^{a}	5.37 ± 1.04^{a}
F6	4.32 ± 1.23^{b}	4.75 ± 1.19^{a}	4.70 ± 1.24^{abc}	4.80 ± 1.20^{b}	4.62 ± 1.06^{abc}	4.77 ± 1.17^{abc}	4.75 ± 1.05^{bc}

* Different letters (a–c) for each formula are significantly different ($p < 0.05$)

different ($p < 0.05$) from F1 and F6 in terms of color, not significantly different ($p > 0.05$) from all formulas in terms of aroma, not significantly different from F4 and F5 in terms of texture ($p > 0.05$), not significantly different from F2 in terms of taste ($p > 0.05$), not significantly different from F1, F2, and F3 in terms of mouthfeel ($p > 0.05$), not significantly different from F1 and F3 in terms of aftertaste ($p > 0.05$), and not significantly different from F1, F2, F3 and F6 in terms of overall properties ($p > 0.05$). However, F5 had the highest mean values of all organoleptic atributes, namely, 5.10 for color, 5.05 for smell, 5.08 for texture, 6.15 for taste, 5.07 for mouthfeel, 5.13 for aftertaste, and 5.37 for overall properties. Therefore, F5 was selected for further analyses.

F5 is composed of 75% yellow sweet potato and 25% red kidney bean and 5% maltodextrin. F5 has lighter yellow and brighter color than the other formulas because of its greater proportion of yellow sweet potato (75%) than red kidney bean. The addition of 5% maltodextrin could also increase the brightness of instant cream soup. This assumption is proved by the average formula score where more yellow sweet potato and more maltodextrin correspond to a higher average score compared with the others. Given its white color, maltodextrin, when mixed with the instant yellow cream soup mixture, would give a bright color. Similarly, Yuliawaty and Susanto (2015) reported that the addition of 5%, 10%, and 15% maltodextrin could increase the brightness of the product of noni leaf extract beverage.

The higher proportion of yellow sweet potato than red kidney bean is associated with high amylopectin levels. Amylopectin content in yellow sweet potato is around 53.03%, whereas the amylopectin content of yellow sweet potato is 31.8 (Pramesti *et al*., 2015). High amylopectin would make the food light, crisp, and crunchy. In addition, it would create high viscosity, stability, and thickening strength. Conversely, high levels of amylose would produce a hard product (Koswara, 2009). Therefore, F5 has a better texture then the other formulas. Moreover, the addition of maltodextrin could increase the solubility of cream soup, producing better texture. The addition of maltodextrin could significantly increase the solubility of powder-shaped products (Chuaychan *et al*., 2015). This phenomenon is related to the hydrophilic characteristics of maltodextrin, which increases solubility.

The higher proportion of yellow sweet potato (75%) than red kidney bean had a higher level of preference in mouthfeel. It was also associated with an increase in sweetness in instant cream soup. Chuaychan *et al*. (2015) reported that the addition of maltodextrin could significantly increase the solubility of powder-shaped products because of its hydrophilic properties. Instant cream soup powder did not dissolve completely when it was rehydrated and caused fine grains when consumed. Addition of 5% maltodextrin improved the solubility of instant cream soup. Thus, increasing solubility corresponds to fewer insoluble components (such as fibers from yellow sweet potato). Meanwhile, the presence of more insoluble fibers confers instant cream soup with a bad taste. Thus, the aftertaste in F5 was preferable.

Nutrient contents of F5, including moisture, ash, fat, protein, carbohydrate, energy, total dietary fiber, beta-carotene, and protein digestibility, are presented in Table 3. The selected instant cream soup had a moisture of 3.85%. The water content met the quality requirement of SNI 01-4967-1999 (maximum limit 8%). This water content was lower than SNI because of 5% maltodextrin addition and use of drum dryer (outlet temperature of 180°C and inlet temperature of 93°C–96°C). Given its hydrophilic properties, maltodextrin can absorb more water (Parikh, Agarwal & Raut, 2014). In addition, high temperatures would increase the rate of heat transfer into the particles, forcing water to evaporate into the environment or air.

The ash content obtained from the selected product was 3.15%. The mineral content in the selected product was assumed to be derived from yellow sweet potato and red kidney bean. Yellow sweet potato and red kidney bean are high in iron, calcium, and magnesium (Dako *et al*., 2016; Chaudhary & Sheel 2013).

The fat content of the selected instant cream soup was 14.18%, which was higher than the requirement of SNI 01-4969-1999 (minimum limit of 5%) and technical guidelines of supplementary food for expectant mothers with CED (minimum limit of 12%). Fresh cream is fat source in selected instant cream soup (Deosarkar,

Table 3. Nutrient content of selected instant cream soup (F5)

Tested characteristics	Total	SNI 01-4967-1999	Kemenkes (2017)
Water (%)	3.85	Max. 8	-
Ash (%)	3.15	-	-
Fat (%)	14.18	Min. 5	Min. 12
Protein (%)	30.19	Min. 10	Min. 6
Carbohydrate (%)	48.63	-	-
Total dietary fiber (%)	18.31	-	-
Energy (kcal)	443	-	Min. 270
Beta-carotene (ppm)	87	-	-
Protein digestibility	77.21	-	-

Khedkar, Kalyankar, & Sarode, 2015). The protein content obtained from the selected cream soup was 30.18%. Red kidney bean as a source of protein in this product contributed about 6 g of protein. The value was higher than the requirement of SNI 01-4969-1999 (minimum limit of 10%) and technical guidelines of supplementary food for expectant mothers with CED (minimal limit 6%). The protein contribution of F5 relative to the nutritional label reference (2016) was 39.7%. The selected instant cream soup can be claimed as "a high protein" because it meets the requirement of BPOM RI. (2016) that a food product can be declared as a "high protein" if it contains no less than 35% of the Nutrition Label References per 100 g in solid form. The protein content in the product possibly originated from the chosen raw ingredients, including red kidney bean, chicken, soybean protein isolate, and egg white flour, of the selected instant cream soup. The carbohydrate content acquired based on this method was 46.03%. The main sources of carbohydrate in this product were maltodextrin and yellow sweet potato. Maltodextrin contributed 26.42 g of carbohydrate. Meanwhile, yellow sweet potato contributed 22.08 g of carbohydrate.

In accordance with BPOM RI (2016), a food product can be declared as a "high dietary fiber" if it contains no less than 6 g per 100 g solid form. The dietary fiber of the selected instant cream soup was 18.31 g per 100 g. Thus, this product can be claimed as high dietary fiber. The energy content of the selected instant cream soup was 443 kcal, which was higher than the requirement of technical guidelines of supplementary food for expectant mothers with CED (minimal limit 270 kcal). Carbohydrate was the biggest energy contributor (195 kcal/100 g), and protein was the lowest energy contributor (121 kcal/100 g) in this selected instant cream soup. This energy content contributed 14.10% of Nutrition Label References.

The beta-carotene content in this selected product was 87 ppm or 725 mcg RAE. To be considered "high vitamin A," a product must contain at least 30% of 816 mcg RAE or equivalent of 244.8 mcg RAE based on BPOM, 2016. Thus, this instant cream soup can be claimed as high vitamin A. Vitamin A could increase hemoglobin status in pregnancy. Vitamin A supplementation could increase hemoglobin level by 0.2–1.0 g/dL during 2 weeks of supplementation in maternal CED (Radhika *et al*., 2002).

The protein digestibility of the selected instant cream soup was 77.21%. This parameter is dependent on factors that may be internal and external to the protein. Internal factors included protein amino acid profile and protein folding and crosslinking. Muchtadi (2010) stated that animal protein is complete and high quality because it contains complete essential amino acids, making its digestibility high. Red kidney bean and soy protein isolate have limited amino acids in a food product because they contain less of methionine and cysteine. Moreover, the preparation of the selected product involved high temperature. In heat treatment, proteins may lose their tightly folded structure by thermal denaturation (Joye, 2019). Protein denaturation caused the protein to lose its strong folding structure (protein folding), thereby limiting access of peptide bonds to hydrolytic enzymes (proteases). Protein unfolding is caused by protein denaturation, which decreases protein digestibility (Carbonaro *et al*., 2000). In addition, protein denaturation causes several molecules to separate from their insoluble sub-units. Then, the combination of these molecules formed an aggregate. The aggregate would precipitate and reduce protein digestibility (Gilani *et al*., 2012).

The presence of anti-nutritional substances (external factor), such as trypsin inhibitors and phytic acid derived from red kidney beans and soy protein isolates (Gilani *et al*., 2012), also caused the low protein digestibility of the selected product. The anti-nutritional substances would reduce the protein digestibility by inactivating the peptidase. In addition, the total food fiber content of instant cream soup was 18.31 g. The high fiber content (external factor) in this selected instant cream soup could reduce protein digestibility. Food fiber would increase the viscosity of food (instant cream soup) in the digestive tract (gastrointestinal tract), so that the hydrolytic enzymes (proteases) would diffuse slowly in producing amino acid substrates (Lin *et al*., 2019).

The amino acid score was analyzed in this study (beside protein digestibility) to determine protein quality. This method is a simple and inexpensive means of determining the limiting amino acids. Amino acid profiles and amino acids score are presented in Table 4. Amino acids with the greatest proportion of instant cream soup were glutamic acid (122.66 mg/g protein), aspartic acid (79.19 mg/g protein), and arginine (50.35 mg/g protein). Glutamic acid mainly serves as the oxidative fuel and key neurotransmitter in the intestine; thus, it has a potential to improve intestinal function. The digestive system of babies is usually sensitive to stress, notably at the beginning of weaning. This phenomenon causes negative growth and pathological matters related to immune function and the digestive tract. In this case, glutamic acid could act as a source of oxidative energy in the intestine and immune system cells (Curi *et al*., 2007).

Glutamic acid is also a precursor of arginine as well. Arginine is a semi-essential amino acid required during

Table 4. Amino acids profile and amino acid score

No.	Type of amino acid	Total (mg/g protein)	Reference amino acid (FAO, 1973)	Amino acid score (AAS)
1	Hisitidine	19.21	-	-
2	Isoleucine	38.09	40	95
3	Leucine	60.95	70	87
4	Lysin	57.47	55	100
5	Methionine + cysteine	16.4	35	47
6	Phenylalanine + tyrosine	60.28	60	100
7	Threonine	28.65	40	71
8	Tryptophan	11.26	10	100
9	Valine	42.4	50	85
10	Aspartate	79.17	-	-
11	Glutamate	12.56	-	-
12	Serine	35.28	-	-
13	Glycine	35.77	-	-
14	Arginine	50.35	-	-
15	Alanine	42.56	-	-

pregnancy due to placental and fetal growth, increased catabolism, and increased production of nitric oxide (NO) in vascular function. Arginine is a NO synthase substrate, and NO is a vasodilator that regulates blood flow and tissue perfusion. Pregnancy is characterized by an increase in blood volume and cardiac output, and interference with vasodilation during pregnancy is related to the incidence of preeclampsia (Nielsen, Wheaton, Iii, & Oberlies, 2007). Gao *et al*. (2012) mentioned that supplementation of 6 g arginine in healthy people could increase plasma nitrite and reduce systolic blood pressure.

The limiting amino acid of instant cream soup was 47. This result showed that the maximum amino acid that could be used by the body was only 47% of the total protein contained in the instant cream soup, even though the content of other essential amino acids was higher. The amino acid that had the lowest score was sulfur amino acid (methionine + cysteine). This finding is in line with the finding of Caire-Juvera *et al*., 2013) that the limiting amino acids in beans are methionine and cysteine with a score of 41–47. Fortification of food from animal sources, such as meat, milk, cheese, fish, and cereals, could increase amino acid scores in instant cream soup products.

Product acceptability in pregnant women was surveyed. Acceptance test for pregnant women was carried out using a hedonic test, which could describe the preferences for instant cream soup. The number of pregnant women involved in the acceptance test was 100. During the test, each participant was asked about the taste of the instant cream soup and then provided a score on each attribute. Scoring in acceptance test was the same as that in the organoleptic test. A food product was accepted by pregnant women if the percentage of pregnant women who rejected (dislike) the product was less than 50% (Setyaningsih & Apriyantono, 2010).

Pregnant women who gave a score of 4 (neutral) or more on each attribute were considered to like the product. Of the 100 pregnant women, 85% received color, 87% received smell, 80% received texture, 79% received taste, 84% received mouthfeel, 82% received aftertaste, and 87% received the overall properties of the instant cream soup (Table 5). This acceptance was evidenced by the values given by pregnant women to each attribute >4. In conclusion, on average 83% of the pregnant women liked and received instant cream soup for consumption.

Table 5. Acceptance test of instant cream soup in pregnant women

Attributes	Percentage of acceptance (%)
Color	85
Smell	87
Texture	80
Taste	79
Mouthfeel	84
Aftertaste	82
Overall	87

CONCLUSION

The formulation with 3:1 and 5% yellow sweet potato and red kidney bean ratio and 5% maltodextrin addition (F5) was selected on the basis of the hedonic organoleptic test. Nutrient content analysis showed that the product contained 3.85% water, 3.15% ash, 30.19% protein, 14.18% fat, 48.63% carbohydrate, 443 kcal energy, 17.67% dietary fiber, 87 ppm beta-carotene, and 77.21% protein digestibility. The maximum and minimum amino acid scores were 100% and 47%, respectively. Metinonine and cysteine were the limiting amino acids in the selected product with a score of 47%. This product could be claimed as high protein, vitamin A, and dietary fiber. In addition, 87% of the pregnant women accepted instant cream soup. Thus, instant cream soup could be an alternative food for pregnant women with CED. In further studies, animal products and cereals should be added to increase product protein quality. In addition, fresh or instant cream soup products must be developed through pasteurization for practicality and simplicity.

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CONFLICT OF INTERESTS

Non relevant to the topic of this studies. The author's studies were supported by grants from the Ministry of health of the Republic of Indonesia.

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