Formulation and Optimization by Experimental Design of Dairy Dessert Based on *Lupinus albus* L. and *Stevia rebaudiana* Extracts

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**ABSTRACT**

The approximate chemical composition and amino acid profile of *Lupinus albus* seeds were studied. Protein content of lupin and lupin milk seeds; 45.2(±0.09) g/100g and 7.25(±0.08) g/100g, respectively; fat content 9.04(±0.14) g/100g and 6.01(±0.06) g/100g, respectively. Lupin seeds rich in leucine, lysine and proline: 4.168; 4.059 and 2.620 (g/100 g) respectively. This work made it possible, using the experimental design method, to carry out eighteen trials of dessert cream formulated with different concentrations of lupin milk. The reduction of the quantity of sucrose used to 7.15% instead of 11% and the use of 3.85% *Stevia rebaudiana* extract have resulted in a dessert cream that is lighter in sugar. The chemical properties of the formulated tests revealed a high protein content ranging from 8.96 to 16.25 g/100 g and a fat content ranging from 3.50 to 4.92 g/100 g. Finally, an optimal formula was developed with good sensory characteristics.

**Key words:** Cream dessert, Experimental design, *Lupinus albus*, *Stevia rebaudiana*, Lupin milk.

**INTRODUCTION**

Lupins are a part of the large family of leguminous plants, particularly Papilionaceae (Huyghe and Papineau, 2004). Lupin seeds are often consumed as an appetizer; furthermore, lupine seeds are milled into flour and used as food ingredient for the manufacture of baked goods (bread, cakes, muffins, crackers, etc.) and dairy products, as well as fermented foods (Villarino et al., 2016).

The addition of lupin seeds flour or lupin-based processed foods reduced the risk of dyslipidaemia, diabetes, obesity, hypertension and bowel dysfunction (Guillon and Champ, 2002, Arnoldi et al., 2015, Villarino et al., 2016). These effects are probably caused by the synergistic activities of lupin seed components, including specific proteins, dietary fibres and bioactive compounds (Arnoldi et al., 2015). All of the bioactive compounds present in lupin seeds, phenolic compounds are primarily responsible for the antioxidant capacity of the seeds (Khan et al., 2015).

Since, lupin is gluten free, it is sometimes used as a main ingredient in gluten free food (Scarafoni et al., 2009).

Fresh milky desserts include a wide variety of products from milk-based traditional and homemade recipes. Nowadays, this preparation evolves by modernizing the traditional recipe. These preparations contain mainly milk, which is mixed to other ingredients such as sugar, coffee, chocolate, cream, flavors and colors (Morais, 2014). Therefore, their production requires systematic heat treatment and hygienic packaging (Romain, 2008). The technology used to industrial preparation of cream dessert should preserve the nutritional components of milk such as an average proportion of calcium (110-140 mg/100 g) and sugar (11-18 g/100 g) (Mahaut et al., 2000).

Lupin could substitute soy in the human diet; however it has not received sufficient attention by the industrial sector. However, this situation may change; by extending studies about the creation of food mixture that contain mainly vegetable proteins. Recently, some studies had used lupine seeds to produce milk substitutes, as it has been done before by soybeans (Jayasena et al., 2010, Elsamani et al., 2014). Thus, substitution or supplementation of cow’s milk with lupine milk would improve the production of healthy cream dessert.

**MATERIALS AND METHODS**

For this experimental work, we used milk powder of 26% fat, corn starch, pectin and cocoa powder. These products were kindly provided by the Arib dairy (Ain defla, Algeria). *Lupinus albus* seeds originated from Egypt were purchased (Ain defla, Algeria). *Stevia rebaudiana* extract was used in its liquid form of 10% concentration and manufactured by Ethnoscience (France, Europe). The reference product (RF)
is made from 1.5% fatty reconstituted-milk, milk powder, sugar, starch, carrageenan, salt, cocoa powder and chocolate flavor.

Chemical composition of *Lupinus albus* seeds, lupin milk and reconstituted milk

Using the official method AOAC (1990), the dry matter, protein, fat and ash contents were determined in *Lupinus albus* seeds, reconstituted milk, Lupin milk. Total sugar was determined using the Dubois method. Calcium content was determined according to Chapman and Pratt (1982).

Determination of amino acids profiles of *L. albus* seeds

The amino acid profiles of *L. albus* seeds were made in the Turkey Scientific and Technical Research Institute Marmara Research Center (TUBITAK MAM), using the high-performance liquid chromatography (HPLC) method. A pre-column derivatization method is used for the analysis, where the amino acids are derivatized to PTC (phenylthiocarbamyl) by a PITC (phenyl isothiocyanate) reagent. Separation and detection occurred on a reversed-phase analytical column of high performance liquid chromatography (UFLC-UV) at (254 nm) (Dimova, 2003; Shimadzu, 2007; Ghesheghli *et al.*, 2008). A method for tryptophan analysis was developed using HPLC with fluorescence detection. Tryptophan was detected using excitation and emission wavelengths at 280 and 340 nm, respectively (Zhang *et al.*, 2009). Amino acids contents were calculated by comparing the sample peak area with the standard curves and the values were expressed as (mg/100g).

Preparation of the aqueous extract of *L. albus*

Lupin extract (lupin milk) was extracted from the seeds according to the protocol of Elsamani *et al.* (2014).

Briefly, after manual cleaning, seeds were boiled in distilled water for 30 minutes to stop germination during soaking. The seed coat was manually removed and the cotyledons were soaked in distilled water at a ratio of 1:3 (W/V) during 3 days at room temperature. Soaking water was frequently changed to remove the alkaloids responsible for the bitter taste. At the end of soaking, the cotyledons were rinsed and then crushed using kitchen blender (Philips, HR2097/00, France) for 5 min. To facilitate the grinding, hot water (40-50°C) was added in the blinder to a ratio of 100g/800 ml. The milled material then obtained was homogenized using an ultrasonic homogenizer and then centrifuged at 2600 g for 5 min. The extract was filtered through Wattman paper No 4 and the filtrate obtained was lupin milk. This latter was thermally treated at 100°C for 20 minutes to inactivate the lipoxygenase activity and then cooled and stored at 4±1°C for further processing.

Experimental approach and adopted model

The method used in this study is the mixing plan, named also experimental designs. The purpose is to accurately determine the effect of each factor on the properties of our product and to determine the optimal formula that gives results close to the reference product.

The objective studied refers to the use of a nonlinear polynomial model. The mathematical model adopted in this case is that of the second degree [Equation 1]. It is four-factor model: reconstituted milk, lupine milk, starch and pectin. In fact, only factors that vary in the mixing plane were considered. This model was represented by the following formula:

\[
y = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_1x_2 + a_6x_1x_3 + a_7x_1x_4 + a_8x_2x_3 + a_9x_2x_4 + a_{10}x_3x_4 + a_{11}x_1x_2x_3 + a_{12}x_1x_2x_4 + a_{13}x_1x_3x_4 + a_{14}x_2x_3x_4 + a_{15}x_1x_2x_3x_4 = \cdots \quad (1)
\]

Where \( y \) was a response, \( x_1, x_2, x_3, x_4 \) were input variables, \( a_0, a_1, a_2, a_3, a_4, a_5, \ldots a_{15} \) were the model parameters. For the plan adopted, the choice was made on the D-optimal plan.

The selected factors and levels were introduced in the modde 6 Umetrics software (Sweden, 2001), which determines the coefficients of the mathematical model, the response curves and evaluates two statistical criteria: The quality of the fit: R2 and the quality of the prediction: Q2. This latter is a measure of how the model predicts responses for new experimental conditions. The good model should have the criteria R2 and Q2 with the numerical value close to the unity.

Preparation of samples

After preparation and reconstitution of partly skimmed milk containing 15% fat, milk was heat treated at 75°C for 20 minutes to ensure its safety and then cooled to 65°C in preparation to add the other ingredients (milk powder, lupine extract, cocoa powder, sugar, starch, pectin, flavor, salt). The mixture was then homogenized and pasteurized at 90°C for 20 minutes. Packaging must be rapidly conducted at 70°C to prevent bacterial contamination. The products were then cooled and stored at 6±2°C for 20 days. Using the mixing plane, we obtained 18 tests to be conducted. Compositions of each test are summarized in Table 1.

 Determination of chemical properties

The prepared dairy dessert were subjected to the same analyzes previously described (dry matter, protein, ash, carbohydrates and calcium contents, except for the fat content which was determined according to Gerber method AFNOR (1999).

Sensory analysis

The sensory evaluations were conducted according to FIL-IDF 99B (1995) with major focus on color, taste, texture, flavor and acceptability. A linear scoring scale (from 0 to 5) was used to assess the perception intensities for the eighteen trials (1 = bad, 2 = acceptable, 3 = good, 4 = very good, 5 = excellent). The test was performed with 45 habitual consumers (25 male and 20 female) of dairy desserts, not trained and representative of the target public. Consumers received an evaluation from followed by the sample and were asked to evaluate the sample in relation to each attribute. Each consumer’s decisions were based solely on the sensory characteristics of the desserts, because product information and formulation were not provided.

Microbiological analysis

According Guiraud (2003), the high risk of contamination during the processing steps, microbiological analysis must be carried out to determine the number of aerobic bacteria growing at 30°C. Furthermore, the detection and enumeration of yeasts and moldiness were also evaluated. Moreover,
RESULTS AND DISCUSSION

Chemical composition of *L. albus* seeds, lupin milk and reconstituted milk

The chemical composition of the three constituents is presented in Table 2. The results showed that lupin seeds contain considerable amount of protein, carbohydrate and fat. Proteins and fat were higher than those reported in other varieties of lupin (Veckerek et al., 2008, Jayasena et al., 2010, Fontanari et al., 2012, Khalid et al., 2016).

However, ash and calcium levels were consistent with other studies in other lupin varieties (Vecerek et al., 2008, Khalid et al., 2016).

| Trial | S (g/100g) | St (g/100g) | C (g/100g) | S (g/100g) | Ar (g/100g) | Pe (g/100g) | Mp (g/100g) | Rm (g/100g) | Lm (g/100g) | Su (g/100g) |
|-------|------------|-------------|------------|------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1     | 3.85       | 1.899       | 1.8        | 0.11       | 0.05        | 1.199       | 2.7         | 31.835      | 49.407      | 7.15        |
| 2     | 3.85       | 1           | 1.8        | 0.11       | 0.05        | 2           | 2.7         | 79.34       | 2           | 7.15        |
| 3     | 3.85       | 3           | 1.8        | 0.11       | 0.05        | 0.5         | 2.7         | 79.34       | 1.5         | 7.15        |
| 4     | 3.85       | 3           | 1.8        | 0.11       | 0.05        | 0.5         | 2.7         | 52.8933     | 27.9467     | 7.15        |
| 5     | 3.85       | 3           | 1.8        | 0.11       | 0.05        | 2           | 2.7         | 0           | 79.34       | 7.15        |
| 6     | 3.85       | 2.66333     | 1.8        | 0.11       | 0.05        | 0.5         | 2.7         | 0           | 81.1767     | 7.15        |
| 7     | 3.85       | 1           | 1.8        | 0.11       | 0.05        | 2           | 2.7         | 39.67       | 40.67       | 7.15        |
| 8     | 3.85       | 2           | 1.8        | 0.11       | 0.05        | 2           | 2.7         | 39.67       | 40.67       | 7.15        |
| 9     | 3.85       | 3           | 1.8        | 0.11       | 0.05        | 2           | 2.7         | 79.34       | 0           | 7.15        |
| 10    | 3.85       | 1           | 1.8        | 0.11       | 0.05        | 1.298       | 2.7         | 31.934      | 50.108      | 7.15        |
| 11    | 3.85       | 1           | 1.8        | 0.11       | 0.05        | 0.5         | 2.7         | 79.34       | 3           | 7.15        |
| 12    | 3.85       | 2           | 1.8        | 0.11       | 0.05        | 1.25        | 2.7         | 79.34       | 1.75        | 7.15        |
| 13    | 3.85       | 1           | 1.8        | 0.11       | 0.05        | 0.829999    | 2.7         | 0.659998    | 81.85       | 7.15        |
| 14    | 3.85       | 1.899       | 1.8        | 0.11       | 0.05        | 1.199       | 2.7         | 31.835      | 49.407      | 7.15        |
| 15    | 3.85       | 1.899       | 1.8        | 0.11       | 0.05        | 1.199       | 2.7         | 31.835      | 49.407      | 7.15        |
| 16    | 3.85       | 3           | 1.8        | 0.11       | 0.05        | 1           | 2.7         | 0           | 80.34       | 7.15        |
| 17    | 3.85       | 1           | 1.8        | 0.11       | 0.05        | 1.66        | 2.7         | 0           | 81.68       | 7.15        |
| 18    | 3.85       | 1.33        | 1.8        | 0.11       | 0.05        | 0.5         | 2.7         | 0.659998    | 81.85       | 7.15        |

S: Stevia, St: Starch, C: Cocoa, S: Salt, Ar: Aroma, Pe: Pectin, Mp: Milk powder, Rm: Reconstituted milk, Lm: Lupin milk, Su: Sugar.

| Composition (g/100g) | Lupinus albus seeds | Reconstituted milk | Lupin extract |
|---------------------|---------------------|--------------------|---------------|
| Protein 45.2±0.09    | 3.51±0.09           | 7.25±0.08          |
| Fat 9.04±0.14        | 1.50±0.10           | 6.01±0.06          |
| Total sugar 30.40±0.07| 2.00±0.10          | 4.14±0.03          |
| Dry matter 95.5±0.07 | 10.52±0.12          | 11.34±0.07         |
| Ash 3.01±0.15        | 1.23±0.09           | 0.44±0.08          |
| Calcium 0.35±0.07    | 0.12±0.09           | 0.08±0.12          |

*Means in a row with different letters are significantly different (P ≤0.05).
The protein content of lupine milk is 6 times lower than that of lupin seeds, but it is even higher than that of cow’s milk. The decrease in the protein content of lupin milk may be due to the removal of the seed coat, which may contain certain proteins, as well as the removal of soluble proteins during milk processing (Erbas, 2010; Elsamanii et al., 2014). The fat content was significantly (p<0.05) higher in lupin milk than in cow’s milk.

**Amino acids composition of *Lupinus albus* seeds**

The average composition of amino acids is compared with previously published analyses for *L. albus*, in Table 3. The two analyses of *L. albus* are very different except for methionine in which similar. *L. albus* had higher levels of leucine and lysine a lower levels of glutamic acid and aspartic acid compared to the results of Nalle et al. (2012) and Yorgancilar et al. (2014). All white lupin cultivars were moderate sources of lysine, but deficient in methionine and cysteine (Nalle et al., 2012).

**Chemical and sensory characteristics of cream dessert**

Chemical and sensory characteristics of the 18 tests are summarized in Table 4. Significant differences (P<0.05) were obtained between the samples with respect to all the characteristics evaluated, indicating that the addition of lupin milk, texturing agents and sweeteners affects the chemical and compositional properties of chocolate dairy desserts.

The dry matter content of the eighteen tests lies in the range (23.32-29.80g/100g) compared to 24.40g/100g for the reference product. According to Morais et al. (2014), content may vary from (29.76 to 41.77g/100g) for prebiotic and diet/light chocolate dairy dessert. The dry matter content increased by the addition of starch, pectin and milk powder.

| Trial | Dry matter (g/100g) | Protein (g/100g) | Fat (g/100g) | pH | Total sugar (g/100g) | Ashes (g/100g) | Calcium (mg/100g) | Color | Taste | Texture | Flavor | Acceptability |
|-------|---------------------|------------------|-------------|----|----------------------|---------------|------------------|-------|-------|---------|--------|---------------|
| 1     | 24.8 ± 1.62 ± 4.39  | 6.38 ± 7.21      | 0.63 ± 90.25 | 4.01 ± 5.45 | 2.14 ± 2.7 ± 3.77 |
| 2     | 24.6 ± 10.34 ± 3.56 | 6.26 ± 7.84     | 1.0 ± 115.68 | 3.98 ± 4.26 | 3.32 ± 4.49 ± 3.45 |
| 3     | 29.8 ± 9.21 ± 3.62 | 6.21 ± 7.92     | 0.94 ± 115.35 | 4.02 ± 4.51 | 4.38 ± 4.72 ± 4.67 |
| 4     | 24.9 ± 12.32 ± 4.63 | 6.29 ± 7.62     | 0.81 ± 98.5  | 3.73 ± 4.22 | 3.01 ± 4.59 ± 4.56 |
| 5     | 24.19 ± 15.71 ± 3.91| 6.34 ± 7.07     | 0.49 ± 50.85 | 3.51 ± 4.45 | 4.97 ± 4.61 ± 3.19 |
| 6     | 24.65 ± 15.81 ± 3.66| 6.32 ± 7.17     | 0.46 ± 50.57 | 3.82 ± 4.15 | 4.89 ± 4.74 ± 5.25 |
| 7     | 24.66 ± 15.46 ± 3.71| 6.41 ± 7.91     | 0.44 ± 50.68 | 4.01 ± 4.35 | 4.53 ± 4.57 ± 3.94 |
| 8     | 29.2 ± 13.68 ± 4.92 | 6.28 ± 7.46     | 0.79 ± 97.04 | 3.82 ± 4.76 | 4.34 ± 4.45 ± 3.75 |
| 9     | 28.05 ± 8.36 ± 3.63 | 6.44 ± 14.21    | 1.02 ± 116.2 | 3.76 ± 4.65 | 3.84 ± 4.36 ± 4.34 |
| 10    | 24.84 ± 16.25 ± 4.35 | 6.3 ± 7.27      | 0.74 ± 91.54 | 3.91 ± 4.75 | 4.95 ± 4.75 ± 3.12 |
| 11    | 24.4 ± 10.54 ± 4.1  | 6.43 ± 7.91     | 0.91 ± 115.01 | 4.05 ± 4.86 | 3.18 ± 4.53 ± 3.26 |
| 12    | 24.04 ± 9.33 ± 4.1  | 6.44 ± 7.9     | 0.89 ± 114.35 | 3.81 ± 4.9 | 4.37 ± 4.34 ± 4.52 |
| 13    | 23.63 ± 15.31 ± 3.77 | 6.29 ± 7.14   | 0.45 ± 50.77 | 3.74 ± 4.73 | 2.91 ± 4.15 ± 3.36 |
| 14    | 24.7 ± 14.61 ± 4.34 | 6.3 ± 7.3 | 0.71 ± 91.05 | 3.95 ± 4.55 | 3.37 ± 4.45 ± 2.76 |
| 15    | 24.94 ± 14.59 ± 4.35 | 6.29 ± 7.31   | 0.68 ± 90.6 | 3.86 ± 4.73 | 3.45 ± 4.26 ± 3.55 |
| 16    | 24.52 ± 15.63 ± 3.95 | 6.3 ± 7 | 0.47 ± 50.7 | 4.06 ± 4.65 | 2.45 ± 4.66 ± 2.95 |
| 17    | 23.32 ± 15.85 ± 3.85 | 6.3 ± 7 | 0.44 ± 50.6 | 3.75 ± 4.48 | 1.95 ± 4.71 ± 2.25 |
| 18    | 24.66 ± 15.98 ± 3.81 | 6.45 ± 7.11  | 0.48 ± 50.75 | 3.86 ± 4.34 | 1.18 ± 4.53 ± 3.45 |
| Rt    | 24.4 ± 8.35 ± 3.64 | 6.5 ± 10.24    | 1.09 ± 117    | 4.01 ± 4.32 | 4.34 ± 4.57 ± 4.64 |

*References: Nalle et al. (2012) and Yorgancilar et al. (2014).
product. Nevertheless, the given value by Morais et al. (2014) is 1.71 to 2.12 g/100g.

The formulated mixtures had higher protein content compared to the reference product. This amount of protein intake was provided by Lupinus albus extract and increasing the amount of this latter in the mixture will increase the total protein intake in the cream dessert. According to Ciqual (2013), cream dessert should contain (3.60-5.20g/100g) of protein. Morai et al. (2014) found a value ranged from (6.65-7.07) g/100g.

Even if some of our trials had low calcium content, due to the small amount of milk added to the mixture, many trials were consistent with the reference product. This is consistent with the reference values established by the Nutritional Composition Table Ciqual (2016) for appetized chocolate cream dessert (89.70 mg/100g) and appetized vanilla cream dessert (141mg/100g).

Carbohydrates content in our mixtures was lower than the reference product (20.24 g/100 g) and compared to the nutritional composition table Ciqual (2016) (16.8% for vanilla cream dessert and 21% for chocolate cream). This finding could be explained by the fact that we replaced 35% sucrose with Stevia rebaudiana extract in order to reduce the amount of sugar in cream dessert. Furthermore, stevia extract has sweetening power 250-300 times more than table sugar and gives fewer calories which could improve the nutritional quality of cream dessert.

According to Wanger (2012) Stevia is a natural alternative to sugar but the delay in the appearance of its taste incited us to combine it with sucrose. The initial amount of sugar was 11g/100g in the standard formula; however we substituted 35% of sucrose with Stevia rebaudiana extract. This partial substitution allowed prolonging the sweet taste in the mouth of consumers. A mixture with sucrose where rebaudioside A contributes 15% to 50% of the sweetness has taste and time profiles very similar to those of sucrose with fewer calories (Carakostas et al., 2012). High intensity sweeteners are increasingly used by consumers looking for products with reduced sucrose content, either for their reduced energy content or because of the requirements of people with diabetes mellitus (Cadena and Bolini, 2011; Palazzo and Bolini, 2014).

After selecting for each mixture as well as for the reference product the adequate terms; texture, flavor, color, taste and overall acceptability which we think are the most relevant to describe the products.

Mixtures 1, 13, 16, 17 and 18 had less viscous texture than the other mixtures, due to the use of insufficient texture agent (pectin and starch), which affected their acceptability by tasters. These formulations presented the highest viscosity values and this increase may reduce sweetness perception in foods (Lethuaut et al., 2003). Kersiene et al. (2008) demonstrated that a close relationship between the flavor release and the food matrix exists, such as the starch three-dimensional structure that is capable of the inclusion of various hydrophobic volatiles.

Microbiological analysis
After 20 days of storage at 6±2°C, the microbiological analysis revealed total absence of total mesophilic aerobic bacteria, total Coliforms, fecal Coliforms, yeasts and moldiness, Staphylococcus aureus and Salmonella in all our mixtures and the reference product. These results are consistent with the Algerian microbiological standard for gelled milks (JORA, 1998).

Total absence of these germs confirms that mixtures were conducted according to the hygiene rules to prevent any contamination during all the steps of processing, packaging and storage. Furthermore, total absence of coliforms indicates the effectiveness of heat treatments (Guiraud, 2003).

Response Surface Modeling
Choice of answers was based on the results of the determinations which influence the studied objective and which consequently show significant variations between the mixtures. The unknown coefficients of the model were calculated for each of the responses using Partial least squares regression (PLS regression) performed by Modde 6 software. The obtained mathematical models can thus be written as follows:

Proteins = 14.933 - 0.317x1 - 0.048x2 + 1.062x3 - 1.045x1x2 - 0.144x1x3 - 0.017x2x3 - 0.019x1x2x3 - 0.1 - 414x1x2x3 + 0.161x1 - 0.274x2 - 0.405x3 - 0.420x2x3
Calcium = 94.319 + 0.901x1 + 0.494x2 + 14.007x3 - 13.992x1 - 0.345x1x2 + 0.289x2x3 - 0.222x1x3 - 0.269x1x2 - 0.299x2x3 + 1.157x1x3 - 6.420x1x2x3 - 2.412x1x2x3 - 1.151x1x2x3
Acceptability = 3,377 + 0.173x1 + 0.009x2 + 0.189x3 - 0.193x1 - 0.024x1x2 + 0.142x2x3 - 0.142x1x2x3 - 0.021x1x2x3 - 0.142x1x2 - 0.060x3 - 0.122x2 - 0.014x3

Once validated, these mathematical models were then represented graphically by iso-responses curves (Fig 1). Graphical representation of the curves isoresponses within the domain of study of protein response, calcium and acceptability.

According to the obtained graphs, gradual increase in the volume of milk and lupine extract strongly increased protein and calcium contents. Furthermore, pectin could improve the acceptability of cream dessert, whereas starch negatively affects the acceptability as the texture will be affected and the appearance will be granular. The negative influence of the lupine extract on the acceptability response has been confirmed because the texture of the cream dessert will tend to have a fluid texture.

Optimization of the formula
It is sought to obtain a product which is rich in proteins and calcium and organoleptically acceptable. We choose to maximize the three responses. The optimum will be deduced by derivation of the model equation to find X values factors to maximize the three responses. The optimum will be deduced by derivation of the model equation to find X values factors to maximize the three responses.
By the addition of lupine milk we decreased the amount of milk used in the manufacture of dessert, which reduces the milk import bill to fill the deficit records the supply chain response to the demand of consumption of certain countries.

**CONCLUSION**

Modeling the responses according to different factors such as partly skimmed reconstituted milk, lupine milk and texture agents (starch and pectin), reviled the individual effect of each component on the overall properties of cream dessert. The obtained formula gave products with good nutritional values, textural and taste properties. We successfully produced products that contain less sugar but provide the body the essential nutrients such as vegetable and animal proteins, essential fatty acids and calcium. Futures studies should be conducted to assess the antioxidant activity, lipid profile, general biochemical and immune responses of Wistar rats fed with dairy dessert.

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Fig 1: Graphical representation of the curves isoresponses within the domain of study of protein response, calcium and acceptability.
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