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# Development and Nutritional Evaluation of Lactose Free Faba Bean Milk

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## Abstract

Fababean due to the presence of molecules of various bioactive compounds is a multifarious functional food. This study was conducted for development of lactose free fababean milk and its nutritional profile. Faba bean milk is whole fababean water extract with off white emulsion. The lactose free faba bean milk developed by selection of fababean seeds, removal of foreign matters, soaking for overnight, blended, filtration, addition of preservatives, pasteurization, sterilization and packing in sterilized bottles. The developed faba milk analyzed for taste, colour, smell, titrate able acidity, pH, specific gravity, brix, moisture, fat, protein, fibre, ash and total energy. The results of faba bean milk such as taste, colour, smell good/acceptable, titrate able acidity (0.64%), pH (6.62), specific gravity (1.01), brix (12.02%), milk solids not fat (7.98%) lactose (0.0%) moisture (87.98%), fat (3.86%), protein (4.79%), fibre (1.01%), ash (0.4%) and NFE (1.96). Minerals contents that is Calcium (25.8 mg), Sodium (39.1 mg), potassium (126.3 mg), zinc (0.38 mg) and magnesium (17.2 mg) were present in faba bean milk. Many health claims associated due to presence of zinc, iron, catechin flavonoids and phenols i.e. chronic disease, parkinson's disease, heart patients and cancer patients.

***Keywords:*** *Faba Milk; Fababean; Soaking; Lactose Free*

## Introduction

Faba bean (*Vicia faba* L.), also known as field bean, broad beans and horse bean is a major food belongs to legume crop. It is a food source of protein, cultivated in high altitudes of Gilgit-Baltistan and chitral area of Pakistan. Faba bean has an enriched nutritional profile especially micro nutrients [1]. Total production of faba bean as on 2010 was 2.55 metric tons that is very low as compared to soybean [2].

Faba beans are good source of ascorbic acid and folate and also a good source of micro nutrients such as zinc, iron, and niacin. Like peas broad beans contains high amount of plant protein and dietary fiber and also phyto chemicals. A consider able amount of catechins also found in faba beans and there is many health claims about foods with catechins, flavonoids phenols and micro nutrients i.e. good safeguard for chronic disease, heart patients and cancer patients due to their antioxidant properties.

Lab study shown that oxidation of LDL inhibited by catechins increase the function of vascular endothelial and reduce platelet aggregation. Faba bean contains L-dopa compound that can be used to cure Parkinson's disease. L-dopa found in whole faba bean but immature pods and beans have more than dry mature pods [3]. Faba beans green levodopa content ranges from 100 to 50 milligram. Favism a genetic condition caused by fatal hemolytic anemia in certain ethnic group. Faba bean also contain zeaxanthin, lutein α and β-carotene. Flavonoids and chlorophyll also contained in raw faba beans kaempferol and 0.41 and quercetin 2.71 mg/100g. The beans with yellow color has 0.42 and 3.03 kaempferol and 0.41 and quercetin 2.7 mg/100g. Faba bean has no zeaxanthin and lutein has little amount of β-carotene and they also have a very little amount of carotenoids [4]. Broad beans are good source of catechins flavanols or flavan-3-ols, theses beans are good source of flavonols, and myricetin quercetin [5].

## Objective of the Study

The main objective of the present work is to develop a process for the production of lactose free milk for lactose allergic persons. The areas of milk shortage has need of milk substitute, milk from plant based beans already have been developed to overcome this shortage in milk shortage areas this milk. Faba bean are also good source of plant protein this source is comparatively inexpensive as compared to meat protein. Faba milk can be used as vegetable proteins source because as animal proteins due to increasing world population and increasing rates of animal meat is become unavailable to common people. Faba milk and cow milk have similar proteins contents (3.0 - 4.79%) and are fairly close in their amino acid pattern.

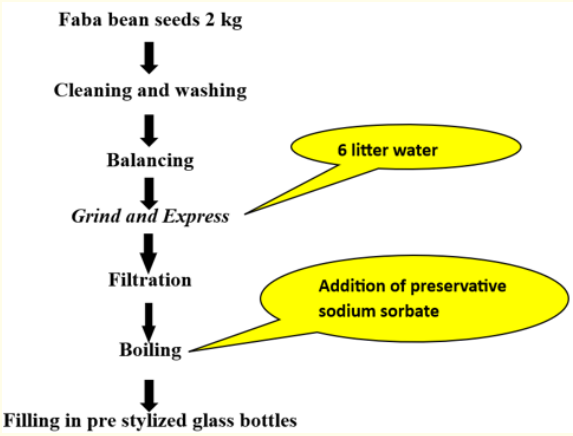
## Materials and Methods

### Preparation of fababean milk

Faba bean seeds (*Vicia faba* L.) purchased from perishing District Astore Gilgit Baltistan and other required materials and additives purchased from Lahore for Preparation of faba bean milk. Manually Faba bean seeds cleaned stones, foreign matters and dust removed. Fababean one kilogram put in water for twelve hours. Then fababean passed through hot water that help to fix color and remove off smell and kill trypsin. Then it was passed from mincer and high speed mixing blander, the minced and blended material allowed for filtration with muslin cloth. The filtered milk pasteurized at 85°C temperature and cooled up to 20°C temperature [6].

Potassium metabisulphite added to preserve the developed fab lactose free milk and sterilized. Glass bottles was already sterilized and dried in oven the sterilized faba milk fill in pre sterilized glass bottles and put in refrigerator.

### Flow diagram of lactose free faba bean milk




***Figure***

### Testing of developed lactose free faba milk for different parameters

#### Total titrate able acidity

Total titrate able acidity of fababean developed milk tested in accordance of Association of analytical chemist method. I took 10 ml milk sample and sodium hydroxide used as titrating reagent, phenolphthalein used as endpoint indicator.

$$\text{Total titrate able acidity} = \frac{0.1X70X0.1X9.6}{10}$$

#### pH

pH of developed lactose free faba milk measured using BANTE instrument pH meter (PHS-25CW). Calibration of pH meter done using buffer seven and four and then measured pH through dipped electrode in faba bean milk until reading stable.

#### Specific gravity

Lactometer used for faba milk specific gravity. Faba milk was taken in Pyrex beaker of 150 ml. The lactometer dipped in beaker up to stem and reading calculated.

$$\text{Specific Gravity} = \frac{\text{Reading} + 1}{1000}$$

#### Degree Brix (°B)

Degree Brix (°B)/total soluble solids determined using HANNA (H196801) refractometer according the method given in Association of analytical chemist method. First refractometer sample holding area cleaned with distilled water and then put three drops of distilled water in refractometer and calculate reading that is 0.0 than dry the sample placing area with tissue after complete dry the milk sample put in refractometer.

#### Milk solid not fat

In accordance to Kirk and Sawyer 1991 [7]. Pyrex beaker 200 ml was taken and added 10 ml sample of faba bean and then added few drops of phenolphthalein, sodium hydroxide 0.1 molar solution added form burette drop by drop until pink color. Formalin solution prepared and then added 3 ml developed solution in same milk sample and again titrated with sodium hydroxide 0.1 molar solution (X). The developed formalin solution neutralized with sodium hydroxide 0.1molar solution (Y).

$$\text{Milk solids not fat\%} = 5.67(X\text{-}Y).$$

### Nutritional value analysis of faba bean milk

#### Percent moisture

Petridis washed and dried and weighed than added Faba bean milk 10 gram (W1) and put in PCSIR Lahore manufactured oven at 100°C for 26 hours. The sample weighed and noted reading and again put in oven for one hour and noted reading the first and second reading was constant so decided to take the same reading (W2).

$$\text{Percent Moisture} = \frac{W1 - W2}{\text{Weight of sample}}$$

### Percent fat

The developed faba milk was passed from spry drier to remove moisture. The moisture free sample was taken for percent fat content analysis. Soxhlet glass apparatus used for extraction of fat with organic solvent petroleum ether AACC 2000 method [8] round bottom flask of 250 ml half filled with petroleum ether and start heating mental at 50°C. The heating continued for five hours. After five hours thimble with sample removed and the flask kept in oven at 100°C and removed after sixty minutes put in desiccator after room temperature the flask weight again.

$$\text{Percent fat} = \frac{(W1 - W2)}{\text{Weight of sample}} \times 100$$

### Percent fiber

For percent fiber determination we took fat free sample of dehydrated faba bean milk. Solution of $H_2SO_4$ (0.255) normal and NaoH (0.313) molar was prepared. The sample two grams was taken in 500 ml Pyrex beaker and added 200ml $H_2SO_4$ (0.255) solution and boiled for 30 minutes. The sample was than filtered and washed with distilled water. Now the filtered and washed material put in beaker and added 200 ml NaoH (0.313) and boiled for 30 minutes and again filtered and the filtered material again washed with distilled water to remove sodium hydroxide residue. The remaining filter collection was put in crucible and put in oven at 130°C for one hour, then removed from oven kept in desiccator after reaching room temperature weighted. The same crucible now put in muffle furnace at 500°C until grey white ash. The procedure and method used as per AOAC 2011 [9].

$$\text{Percent fiber} = \frac{\text{W1 (after drying in oven) - W2 (after ashing)}}{\text{Weight of sample}} \text{X100}$$

### Percent protein

Percent protein in faba milk was determined as per method of AOAC 2011 using Kjeldahl apparatus. Faba dry milk taken 0.2 grams in Kjeldahl tubes and added 25 ml concentrated $H_2SO_4$ and added catalyst tablet in tube. The sample in now digested at 350°C to 400°C for three hours. The digested sample neutralized with 20% sodium hydroxide, after neutralization the material shifted to distillation flask. In 250 ml conical flask added 30 ml 4% boric acid and adjust distillation unit and started distillation until 200 ml distilled water with ammonia collected in flask. The distillation collected ammonia solution now titrated with 0.1N $H_2SO_4$ with methyl red indicator. The percent protein calculated according the formula.

$$\text{Percent nitrogen} = \frac{\text{Atomic weight of nitrogen X normality of Hcl X protein factor titer used}}{\text{Weight of sample}}$$

### Percent ash content

For percent ash content we took 2 grams sample in crucible and ignite in slow open flame for smoke free, the smoke free sample now put in muffle furnace (MF-1/02, PCSIR, Pakistan) at 500°C until grey white ash. The crucible put in desiccator for room temperature and taken weight the loss in weight after oven dry was ash content. The procedure and method used as per AOAC 2011 [9] described for determination of ash content.

$$\text{Percent Ash content} = \frac{(\text{W1 weight after oven dry -W2 weight after ashing})}{\text{Weight of sample}} \text{X } 100$$

### Percent (NFE)

The percent nitrogen free extract of faba bean milk calculated by difference method i.e.

Percent (NFE) = (ash, fiber, moisture, protein and fat) -100

### Mineral content

Mineral content in fababean milk was determined as per the wet digestion method of AOAC 2011. We took 0.5 grams sample of faba bean milk and took 10 ml ammonium nitrate solution and started heating up to 70°C for 25 minutes. Then 50% $HC_1O_4$ added in sample and again digested at 200°C until proper clear of flask. Volumetric flask of 100 ml taken and shift the sample to volumetric flask and volume was made with deionized distilled water. Atomic absorption spectrophotometer was used to analyse the sample. Standard curve got through run of already known strength samples, then obtained slandered curve for (Ca, Na, K, Zn and Mg) each element as per method described in AOAC 2011for mineral content.

## Result and Discussion

Faba bean lactose free milk sample received parameter results discussed below.

### Faba bean milk analysis

Faba bean lactose free milk was analyzed for total titrate able acidity, specific gravity, pH, brix and milk solid not fat through recommended methods of AOAC 2011. Results of above mentioned parameters are given in table 1.

### pH

pH of the faba bean milk influenced due additives, composition and chemical changes. Mean values of pH of faba bean milk was 6.62 (Table 1). Dairy products essence and mouth feel directly related wit pH of milk.

### Total titrate able acidity

The Means for titrate able acidity of faba bean lactose free milk was 0.64. The result pertaining to mean values given in table 1.

| S. No | Parameter | Result (Mean value ± SD) |
|---|---|---|
| 1 | pH | 6.62 ± 1.3 |
| 2 | Total titrate able Acidity | 0.64 ± 0.13% |
| 3 | Specific gravity | 1.01 ± 0.04 |
| 4 | Brix/Total soluble solids | 12.02 ± 0.8% |
| 5 | Milk solid non fat | 7.98 ± 1.7% |
| 6 | Lactose | 0.0 ± 0.0% |

***Table 1:*** *Mean values of different parameters of faba bean lactose free milk.*

### Specific gravity

Faba bean lactose free milk specific gravity was 1.01. Faba milk flavored drink developed the specific gravity of faba bean milk and developed products determined the specific gravity ranged from 1.01 to 0.97 that is a cross referenced with the study of Krishna., *et al*. 2003; Park., *et al*. 2005 [7].

### Degree Brix (°B)

The brix value of fababean lactose free milk was 12.02 i.e. in table 1. Gain (Global alliance for improved nutrition) working to provide a balanced diet in all over the Pakistan. In hilly areas of Gilgit Baltistan due to shortage of milking animals a substitute of milk with faba bean lactose free milk developed and providing to school going students. The developed milk tested for degree brix/ total soluble solids i.e. 12.02.

### Milk solid not fat

Faba bean lactose free milk was 7.98 given in table 1. Ice cream developed with faba bean and mix faba bean and apricot kernel and tested for different parameters. The total solids not fat was higher in mix ice cream that is 7.98 and 10.3. Abdullah also tested four types of ice creams and quoted milk solids not fat ranged from 9.25 to 14% Abdullah., *et al.* 2010 [10].

### Chemical analysis of faba bean lactose free milk

### Moisture

Developed faba bean milk total moisture was 87.98% given in table 2. The increase in moisture content decrees the total energy and increase perishability of product. We also conducted study chocolate faba bean milk and faba milk the moisture content were 86.1% and 87.98%respectively. The results are in accordance to the study of Jhang., *et al*. 2009 [11].

### Crude fat

Faba bean lactose free milk percent fat content was 3.86% given in table 2. Fat provides energy 9kcal per gram, provide taste and aroma to the food also, but access use of fat also dangerous for health. Diet and health conscious peoples preferred for defatted milk and low fat products.

Fat content in faba bean milk was found 3.86%. The results also in resemblance to the study of Raja., *et al*. 2014 that fat content in soy milk was found 2.6%.

### Percent protein

The faba bean developed lactose free milk percent protein content was 4.79 given in table 2. The percent protein increased the quality of product. Amino acids are essential for product structure, flavor and taste as well as energy. The range of protein of faba milk is in resemblance with the study of Raja., *et al*. 2014 i.e. 6-9%.

### Percent fiber

The percent fiber in faba bean milk was 1.01% shown in table 2. A study conducted by Mcdowell., *et al*. 2002 [12] comparison done between soya milk and cow milk. The percent fiber content shown was 0.25%.

### Percent ash

Faba bean lactose free milk contained percent ash content 0.4 given in table 2. Percent ash is the material that is inorganic left after burning at 550°C of organic compounds found in milk. The ash content also a measure of mineral content. A study also conducted by Martinez., *et al*. 2011 [13] to see germination effect of soya bean in soya bean milk. The after two day time of germination the soya milk has nutritionally very sound and other organoleptic characters as compared to without germinated seeds of soya bean.

### Percent nitrogen free extract

The percent nitrogen free extract/carbohydrates of faba bean milk was 1.96 given in table 2.

Rehamn., *et al.* (2007) [14] conducted a study to compare cow milk and soya milk during the study he found that the percent nitrogen free extract/carbohydrates of soya milk was 4.25.

| S. No | Parameter | Result (Mean value ± SD) |
|---|---|---|
| 1 | Moisture | 87.98 ± 1.6 |
| 2 | Crude fat | 3.86 ± 0.8 |
| 3 | Crude protein | 4.79 ± 1.0 |
| 4 | Crude fiber | 1.01 ± 0.4 |
| 5 | Ash | 0.4 ± 0.03 |
| 6 | NFE | 1.96 ± 1.1 |

***Table 2:*** *Mean Nutrition value of faba bean lactose free milk.*

## Mineral contents

Blood pressure of human body regulates by presence on sodium content that is consumed through food sources. It is also responsible to regulate the muscular and nervous functions, so the amount of sodium must be controlled by body. Body fluid activity also concerned with the sodium with potassium ratio. Sodium concentration in faba milk was 39.1 mg given in table 3. Potassium in association with sodium chloride, magnesium and calcium responsible for body electricity. Potassium also responsible for heart function and skeletal and musical contraction. The access of potassium also have negative effect that is slow down of heart function. Potassium in faba bean lactose free milk was 126.3 mg. Digestive and muscular functions also related with potassium [15].

Zinc and iron are considered as immune nutrients. The Zinc concertation in faba bean lactose free milk was 0.38 mg that is given in table. The zinc also responsible for improve immunity and testosterone production in body that considered an important factor for male sexual potency. Zinc is also consider for good wound healer, smell and taste improver, cell breakdown and growth. Magnesium is main manufacturer of RNA and DNA and also works as co-enzyme. Total magnesium content in faba bean lactose free milk was 17.2 mg given in table 3. Calcium is a main constituent, major portion of body calcium utilized in keeping teeth and bone stronger remaining functions in muscle contraction, blood clotting and nerve function. The calcium in fababean lactose free milk was 25.8 mg given in table 3.

| S. No | Parameter | Result Mg/100 (Mean value ± SD) |
|---|---|---|
| 1 | Ca | 25.8 ± 2.8 |
| 2 | Na | 39.1 ± 3.2 |
| 3 | K | 126.3 ± 1.8 |
| 4 | Zn | 0.38 ± 1.2 |
| 5 | Mg | 17.2 ± 1.1 |

***Table 3:*** *Means values of mineral contents of faba bean lactose free milk (mg/100g).*

## Conclusion

Fababean represents an excellent source of high quality protein with a low amount of saturated and Trans fatty acids along with the raised quantity of dietary fibre. The research has shown the possible reduction in the incidence of cardiovascular diseases and it also improves the glycemic load. The isoflavones of the fababean is also associated with prevention and treatment of various types of cancers and other multiple disorders. Thus, it would be beneficial to consider the replacement of animal based food items for the fababean foods in order to achieve the health and nutritional benefits.

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