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Trial Production of a Stirred Yoghurt by the Partial Substitution of Milk Powder by Soymilk

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Abstract
The goal of my work is to try to make yogurt preparations soy milk with different concentrations, this substitution aims to evaluate soybean influence on the physical and chemical characteristics, to ensure the safety of consumers.
The results of the study show that the reconstituted milk powder may be substituted by up to 20% soy milk to produce yogurt without compromising the acceptability of the finished product. And yogurt high protein product and the production technology is developed, can improve not only the socio-economic life of the producers, but also can meet the protein needs of consumers.
In conclusion we can say that soy yogurt has a high nutritional importance and may substitute perfectly yogurt cow's milk for vegetarians and people who have lactose intolerance , so it can mitigate the crisis powdered milk that Algeria ' recognized recently.
At the end of my experiment, I have concluded that soy milk does not ferment well alone with the seeds used for making yogurt because of the absence of lactose.
On this subject several other topics may arise, such as:
The search for new enzymes that can use soy milk as a fermentation medium.
Search aromas adopted may mask the taste and smell of soy and this taking into account the target population (the Algerian consumer).

Introduction
Milk is an excellent source of nutrients such as vitamins, amino acid. Fats, Minerals, proteins and sugar forming an excellent medium for microbial growth (Lovati *et al.*, 2005).
In countries in development and esp2011ecially in tropical regions of Africa south of Sahara (except East Africa), the production of milk and dairy products is limited and expensive (Cederroth et *al*.,2011).
The yogurt is part of the family of fermented milks obtained by the development of specific thermophilic lactic bacteria *Streptococcus thermophilus* and *Lactobacillus bulgaricus* be seeded simultaneously and be alive in the product in an amount of at least 10 million bacteria per gram of product. Yogurt has excellent digestibility compared to milk, even in patients who show intolerance to lactose in milk because yogurt contains less lactose and has a beneficial effect on the intestinal flora (Lam et *al*. , 2003).

In a global context, a food crisis resulting in the significant rise in prices of essential commodities, the supply of milk powder for the production of yogurt has become very difficult and unprofitable.
Faced with these challenges, it is necessary to explore other sources of milk can validly replace cow's milk. Moreover, the plant milk cheaper can be extracted from soybeans and other legumes and used as a substitute for cow's milk (Collomb , 2007). Also the consumption of soy and its derivatives has beneficial effects on health (Rousseau, 2006). Therefore, the combination of the reconstituted powdered milk and soy milk in very hygienic conditions may be yogurt, a good quality product. The development of such yogurt is justified by an evolving competitive business world and particularly demanding or research and development of new products and the quality approach are engines of business expansion (Stauffer, 2004). Thus this study enrolling this logic proposes to partially replace the milk powder soy milk to produce yogurt objective of the study is to develop yoghurt high in protein a milk -based compound with the same characteristics as the control yoghurt produced with reconstituted powder milk .
Our work focuses on soy yogurt formulation tests by substituting each time the milk powder soy milk to study the physical and chemical quality of finished product.

Materials and Methods

Experimentation site

Our work was performed at the laboratory of physicochemical and microbiological analysis of Unit "Treffle" in Blida during the period between January and May 2014.

Sample preparation for processing:

The powdered milk, soybean milk, sugar (sucrose), lactic ferments (strains *Sc.thermophilus Lb.bulgaricus* and frozen at -18 ° C) are the raw materials used for the manufacture of a yogurt soya milk.

Formulation:

Soy yogurt formulation tests are based on the substitution of the milk powder with soy milk. Five different formulas have been developed to study the quality of the finished product. The Table 1.1 gives the various formulations of soy yogurt:
Table 1.1: wording used for making yogurt:

Ingredients	P_1	P_2	P_3	P_4	P_5
Milk powder (g)	120	115	110	60	0
Soya milk (ml)	0	150	200	500	1000
Water (ml)	780	620	580	390	0
Sugar (sucrose) (g)	85	85	85	80	70
Milk powder content (%)	100	85	80	20	0
Soymilk rate (%)	0	15	20	50	100

Manufacturing process and obtaining soy yogurt :

The diagram of the production of flavored stirred yoghurt at the Clover unit is given as

follows:
1. **Reconstitution**: It's the mixture of water + sugar + milk + Soy milk powder of proportion given in table 1.1.
2. Pasteurization is a heat treatment at 95 ° C for 5 minutes in an oven pastor in order to extend the shelf life of milk and the finished product (soy yogurt).
3. **Cooling**: Allow the preparation to cool to room temperature to a temperature of 44-46 ° C to avoid the burn of lactic ferments.
4. **Seeding**: This is the injection of 2 grams of frozen strains of lactic acid bacteria in various preparations.
5. The maturation in an oven at 44 ° C for 3 - 4 hours
6. Brewing and adding flavors
7. Cooling and storage at 4 ° C
8. Packaging

The physicochemical analyzes
Process water
Determination of pH (NF T01-013) According to (AFNOR 1986)
▪ **Mode of operation**
Dip both probes; temperature and pH in both the sample to be analyzed. Wait until the pH stabilization and read the value found.
▪ **Calculation and expression of results**
The pH value is displayed directly on the frame of the apparatus. The measures are expressed in pH unit at 20 ° C.
The pH value displayed on the pH meter

Determination of alkalinity (TA) (NF T90-036)
▪ **Procedure**
In a 200ml beaker , add 100 ml of sample water , add two drops of phenolphthalein , a pink color develops. Otherwise (no staining) TA = 0, which usually occurs in natural waters with a pH below 8.3 .
Then gently pour the acid with an oil, stirring continuously and this until discoloration of the solution.
▪ **Expression of results**
Title alkalinity TA expressed in French degrees (°F) is given by the following formula:

$$TA (° F) = V1 * 5$$

TA expressed in meq / l and given by the formula: TA (meq / l) = V1 / 5
With: V1 is the volume in milliliters of sulfuric acid required for titration.

Determination of the complete alkalinity (TAC) (NF T90-036)
▪ **Procedure**
Use the sample treated earlier or original sample if there is no color. Add two drops of methyl. Again titrate with the same acid until the color change from yellow to orange yellow (pH = 4.3). Ensure that a drop of excess acid will cause color shift, orange yellow to orange red (pH = 4). V is the volume of 0.02 N acid poured from the assay. Subtract this volume 0.5 ml (amount of acid).
▪ **Expression of results**
TAC: expressed in French degrees (°F) given by the following formula:
TAC expressed in meq / l

$$TAC\ (°F) = (V_2\text{-}0{,}1\ ) * 5$$

TAC expressed in meq / l

$$TAC\ (meq / l) = (V_2\text{-}0{,}1\ ) / 5$$

With V2 represents the volume of sulfuric acid needed for the assay.

Determination of hydrometric title (TH) (NF T90-036)

▪ **Procedure**

In a 250 ml beaker, 100 ml of water is introduced to analyze and then adding 10ml of buffer solution pH = 10 and 2 drops of the indicator (the black Erichrome -T). The solution turns purple, then titrated with EDTA with constant stirring until the color change, from purple to blue. The final product of the curve is reached when the last violet shade is gone.

▪ **Expression of results**

The total hardness of the water analyzed expressed in French degrees (°F) is given by the following formula: TH (°F) = V (EDTA)

V: with the volume in milliliters of EDTA required for the titration.

Determination of chlorides in water (Cl-) (NF T90-014)

▪ **Procedure**

In a 250 ml beaker, 10 ml of water is introduced to analyze and then 10 drops of potassium dichromate (K_2Cr - O4) 10% , then titrated with silver nitrate solution in 0.1N up the color change from yellow to brick red.

▪ **Expression of results**:

Cl = 3.5 V *

With: V: The volume required for the titration. Chlorides are expressed in Mg Cl per liter of water (mg / l).

Determination of free chlorine Cl2 (NF T90-037)

▪ **Procedure**

Fill the sample into a 10 ml tube and add after the DPD tablet.

Place the treated tube on the right side of the compartment at the back of the comparator.

Place a second tube containing the sample to be analyzed on the left side in order to take account of the possible color of the sample.

Set facing a white light source, and rotate the disk until two identical colors.

▪ **Expression of results**

The result is shown directly in the hole on the front of the housing.

Physico- chemical analyzes of soy milk:

Determination of pH (AFNOR, 1986)

Procedure:

Prepare a 10% solution of the sample. Measure the pH with a pH meter after calibration

Détermination of dornique acidity (Caid , 2005).

Procedure:

Using a pipette 10 ml, 10 ml is taken of the analysis sample, add two drops of phenolphthalein and titrate with NaOH N / 9 until the indicator changes to light pink that still 10 seconds. Titrated with sodium hydroxide until the appearance of the color pink pale.

Soit "V" the volume of NaOH N / 9.

Expression of results:
The results are expressed directly in ° D.
Dry matter: (AFNOR , 1986).
Procedure:
In the cup of dried and tared aluminum weighing 2 g of milk or dairy product and put it in the dryer, and wait until the stability
See the result on the screen of the dryer.
Expression of results:
The results are expressed by percentage weight
IS % = value displayed on the dryer

Determination of moisture content (powder milk , sugar) (AFNOR, 1986)
The determination of moisture content is based on the estimation of the amount of water contained in the milk powder. The results are expressed in percentage by weight by the formula:

$$MS = 100- \% H\%$$

MS: DM
H%: Moisture

Determination of fat content:
This method is based on the separation of the fat in milk powder by centrifugation at 1200 rev / min. in the Gerber butyrometer , sulfuric acid attack proteins, carbohydrates except the fat. Iso amyl alcohol promotes separation of the two phases.
o Add 10 ml of sulfuric acid into the butyrometer using a graduated pipette.
- Weigh 2.5 g of the milk powder.
- Add 8 ml of water using a pipette.
- Add 1 ml iso amyl alcohol.
- Centrifuge for 5 minutes.
- Allow the butyromètre 7-8 minutes in a water bath at 45 ° C, the fat dry milk expressed in grams per 100 grams of milk powder is given by the following formula: $N_1 - N_0$
N_1 : represents the value reached by the upper level of the fatty column .
N_0 : represents the value reached by the lower level of the fat column .

Results and Discussion

Results of physicochemical analyzes
Results of the analyzes of raw materials
Trial of Water
The results of the physicochemical analyzes of process water are shown in table 2.1.

Table 2.1: Results of physicochemical analysis process water.

parameters		1	2	3	Means	standards OMS
Temperature	°C	20	21	19	20,00	25
pH		7,15	7,08	7,25	7,16	6,5-8,5
TA	°F	0	0	0	0,00	0
TAC	°F	25	26	25	25,33	25-30
TH	°F	14	12	15	13,67	12,0 -15,0
Cl-	mg/l	41	50	45	45,33	<100
Cl_2	ppm	0	0	0	0	0

From the results of Table 2.1 , we note that the trial of the water has a pH close to neutral (pH = 7.53) with a more or less alkalinity and a temperature of 20 ° C , the TA and TAC are respectively (0 ° F and 25.33 ° F) , for the TH, the value found is 13.67 ° F, we also note that the values of Cl and Cl_2 are 45,33mg / l and 0 ppm, however, they are included in the interval required by the WHO standards , which waiting reliability and good control of chlorination process water .
The value of 0 ppm for Cl_2 is due to the presence of free chlorine in the water trial thereby inhibiting the fermentation process (Berk, 1993).
The results of physicochemical analyzes of process water show compliance with the standards set by the WHO, this is due to the use of clean water, filtered and declore for the manufacture of dairy products.

Milk powder:
The following table shows the results of physico-chemical analyzes of milk powder.
Table 2.2: Results of physico-chemical analyzes of milk powder.

Parameters	1	2	3	Means	Standards OMS
humidity(%)	3,26	3,22	3,24	3,24	2,5-4
EST (%)	95,74	96,58	95,76	96,02	95-97
MG (%)	26,2	26,5	27,5	26,73	26-36
titratable acidity (°D)	13	12	11,5	12,16	12-14
pH	6,73	6,25	6,38	6,45	6,15-6,75

From the results in Table 2.2 on the physico-chemical analyzes of milk powder, it is noted that the acidity is 13 ° D and the value of the total dry extract is equal to 95.02 % , as regards the moisture content and the content of the fat values were (3.24% , 26.73 %) respectively.
The parameter levels (acidity, EST, humidity, MG) are however consistent with the standards adopted by the unit (WHO standards). Compliance with the standards of our results shows:

●Good physical and chemical quality of the milk powder which will allow perfect reconstruction without the risk of formation of insoluble clumps.
● A good storage in the industry.
● Good heat treatment process during the manufacture of the powder.
According **Bauh (2001**), good manufacturing conditions, transport and storage as well as hygiene, can have a positive effect on the quality of milk powder. Therefore the milk powder can be used for reconstitution of milk, because it has good physic - chemical quality.

Soy milk:
The average values of physico-chemical parameters of the soybean milk are shown in Table 2.3:

Table 2.3: Physical- chemical characteristics of the soy milk

Parameters	1	2	3	Means	standards OMS
PH	6,66	6,55	6,85	6,68	6,5-7
MG	2,1	2,1	2,1	2,1	1,0 -2,3
EST	17,85	18,02	18	17,95	17-19
titratable acidity (°D)	13	12,9	13,1	13	14

The results obtained in the physicochemical analysis, there is a certain conformity with the standards: Acidity and soy milk pH were respectively 13 and 6.6 , which is fully compliant with standards.
The average grade of the dry extract is 17.95, which is fully compliant with standards.
The fat is in the range of 2.1 standard (1.0-2.3).

Sugar
Table 2.4: Results of physicochemical analyzes sugar

Parameters	1	2	3	Means	standards AFNOR
EST%	99,6	99,7	99,61	99,63	99-99,8
Humidity (%)	0,4	0,45	0,39	0,41	0,2-1

The results of physic chemical analyzes show that the sugar of value the total solids content of 99.63 % and the humidity is 0.41.
These values show compliance with AFNOR standards, according to the value of the moisture and total solids that meet established standards, it indicates:
The proper conditions the sugar storage in the plant level, allowing the water added in the production of yoghurt.
Sugar is well preserved, which will prevent its deterioration by microorganisms (yeasts and molds), also according Harland (2001), sugar is stable when the humidity does not increase and sugar is physico quality - chemical satisfactory due to a compliance with the conditions.
• Storage .
• Packaging .
• Handling .

Results of the analyzes of the finished product:
Results of physicochemical analyzes
Physico-chemical characteristics yogurt

Table 2.5: Results of physico-chemical analysis of the finished product

Parameters	**P 1**	**P 2**	**P 3**	**P 4**	**P 5**
EST (%)	23,05	23,15	23,23	19,42	17,89
MG (%)	2,3	2,4	2,5	2,1	2,1
Dornic Acidity (°D)	90	89	88	60	46
pH	4,40	4,44	4,45	4,58	4,67
Temperature °C	4	4	4	4	4
Soymilk rate (%)	0	15	20	50	100

P: Product
From Table 2.5, on physicochemical analysis of the finished product , we note that :
• The physicochemical characteristics are different from one another yoghurt .
• pH values of yoghurt and 15% to 20% soy milk were very little different (4.44 and 4.45) , but higher than the pH of the control yogurt (4.40) .
• pH values yoghurt 50% and 100% soy milk were significantly different (4.58 and 4.67) which is higher than the pH of the control yogurt (4.40) .
• Increasing the amount of soymilk reduces the acidity of the yoghurt (90%) for the control yoghurt (0%) soy milk, up to (46%) for the yogurt (100%) soymilk .
• However , the first two types of yoghurt 15% and 20% each of soy milk had a dry matter content (23.15% and 23.23 %) that are higher than that of the control yogurt (23,05) . and yogurt at 50% and 100% soy milk each had a lower dry matter content (19.42% and 17.89 %)
• MG values yoghurt and 15% to 20% soy milk were very little different (2.4% and 2.5%) but above the MG control yoghurt (2.3%) .
And yoghurt 50% and 100% soy milk had the same content of MG (2.1%).

Evolution in physicochemical constant soya yoghurt.
* **Dornique acidity Evolution:**

Table 2.6: Results of the evolution dornique acidity

Parameters	T_0 (5mn)	T_1 (1h)	T_2 (3h)	T_3 (4h)	T_4 (5h)	T_5 (24h)
0%	36	50	69	78	87,00	90
15%	35	51	63	73	46,00	89
20%	34	49	61	76	85,00	88
50%	30	40	48	52	58,00	60
100%	22	28	31	35	40,00	46

The curve in Figure 2.1, can appreciate the evolution of the acidity of the five dornique preparations formulated.

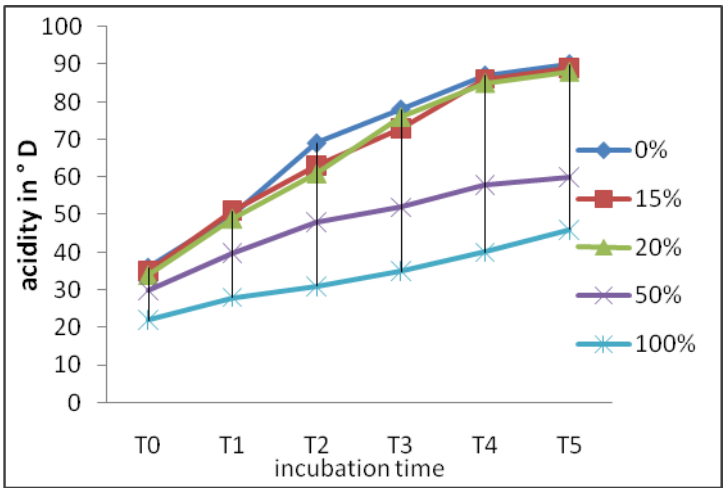

Figure 2.1: Evolution of the acidity of yogurt during maturation

The evolution in the acidity in the yoghurt follows almost the same shape for both the powdered milk and soy milk to different concentrations.

From the graphic presentation in notes that there is an increase in acidity which varies respectively for preparation 0 %, 15 %, 20% , 50%, 100% (36-90) (35- 89), (34-88), (30-60), (22-46).

In milk and milk products, lactic acid derived from the breakdown of the lactose by lactic acid bacteria . The lactic acid concentration in a milk expressed Dornique in degree (°D). Spawning milk contains 15 to 18°D, it quail at 60-70 °D.

Fresh milk degrades under the action of multiple bacteria, some pathogens, other beneficial.

• Lactose main sugar in milk is a fermentation substrate for lactic acid bacteria, which is used in the manufacture of yogurt.

• In the presence of lactase (β -galactosidase), enzyme secreted by the lactic acid bacteria,lactose is hydrolysed to glucose and galactose.

Then, the glucose is converted into pyruvic acid by the glycolysis of all reactions in the cell, so that galactose is excreted out of the cell .

• Finally pyruvic acid is converted to lactic acid.

*__Results of the evolution of pH__:

Table 2.7 : pH evolution results

parameters	T_0	T_1	T_2	T_3	T_4	T_5
0%	6,4	5,3	4,75	4,6	4,44	4,43
15%	6,49	5,41	4,9	4,75	4,50	4,44
20%	6,55	5,5	5,01	4,71	4,50	4,45
50%	6,68	5,73	5,3	4,9	4,55	4,63
100%	6,76	5,86	5,7	5,25	4,70	4,65

The curve in figure 2.3, allows to appreciate the evolution of the pH of the five preparations

formulated

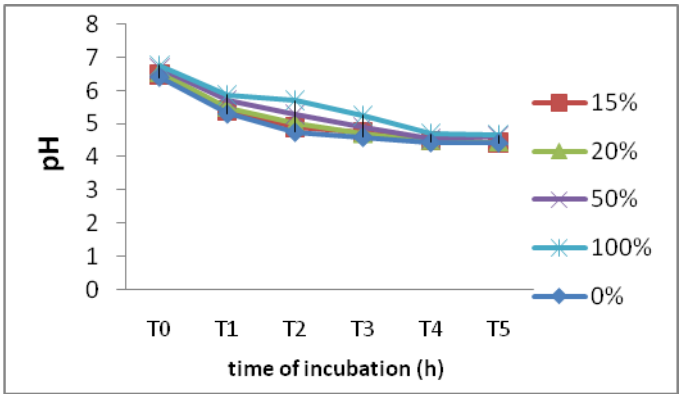

Figure 2.3: pH evolution of yogurt during its maturation.

Of curve 2.3, we finds that the pH decreases In the preparations respectively 0 %, 15 %, 20 %, 50% , 100% are (6,4-4.43) , (6.49 to 4.44) , (6.55 -4.45) , (6.68 to 4.63), (6.76 to 4.65) decrease this confirms the increase in acidity and in accordance with the pH changes during the fermentation of standard (6 , 4 to 4.4) (AFNOR , 1986).

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