WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Production and Development of Dairy Product (Cheese) from Soy-Bean and Tiger Nut as an Alternative to Animal Milk

Ajayi Adebola, Makanjuola Olakunle Moses and Adepegba, Adetokunbo Oluwole

Department of Food Technology, Federal Polytechnic, P.M.B, 50, Ilaro, Ogun State, Nigeria.
E-mail Address: adebola.ajayi@federalpolyilaro.edu.ng

ABSTRACT:

The production and development of Dairy product (cheese) from soy-bean and tiger-nut as an alternative to animal milk were investigated in this research work. The proximate composition, total soluble solids, titratable acidity and pH of the samples were determined using standard methods. The results of the proximate composition calculated on dry weight basis showed that moisture contents for the samples ranged from 61.34±0.01% to 65.56±0.12%, protein contents ranged from 14.08±0.19% to 18.14±0.14%, Fat contents ranged from 0.8.46±0.14% to 10.91±0.28, Ash contents ranged from 0.98±0.24% to 2.01±0.12% while the fibre and carbohydrate ranged from 0.61±0.01% to 0.94±0.15% and 8.81±0.11% to 10.02±0.31% respectively. The total soluble solids, titratable acidity and pH of the samples were significant as compared to the control (p≤0.05). The results of this study demonstrated that the addition of soymilk and tiger-nut milk with whole milk did not necessarily have negative effect on the nutritional quality of the developed cheese product.

Keyword: Dairy product, cheese, soybean, tiger nut, development

INTRODUCTION

Cheese is a general term used to described curdled milk. Cheese according to the national dairy council (2000) is defined as a fresh or matured product which is obtained after curdling of milk's major protein and draining of whey. Cheese is a dairy product with best nutritional value and health care function, and is widely popular in many countries of the world with good taste and diverse flavor (Kahkashan et al, 2011) cheese, a highly nutrition food is one of the numerous products from processing of milk of a cows, goats, sheep, buffalos, camels and yaks, produced by coagulation of the milk protein known as casein (Scott, 1986).

In countries with developed dairy industry and some developing countries, cheese occupies an important position in the resident's dietary structure (Kahkashan et al; 2011). Cheese is an economical source of milk protein. It is rich in calcium, vitamins, nourishing and easily digestible food (Nir, 2004). The contributions of cheese as source of protein, calories, minerals and some vitamins are vital to the development of a good health (Sidding et al, 2018) Talib et al, 2009). Cheese promotes strong teeth and bones. If also enhances the flow of Saliva which helps to wash away food particle in the mouth, thus help to control the development of a plague. It is good for pregnant women because it is known to entrance contractions when the baby is due and also help mothers to produce sufficient milk for the baby.

Soybeans have many uses in human nutrition and are excellent sources of high quality protein. Due to the reported beneficial effects on health and nutrition, soy foods consumption and the use of soymilk in human diets are increasing (Rinald oni et al, 2014). However, not much research has been done in tiger nut milk as a source of vegetable milk (According to Mason (2005), tiger nut have a high content of soluble glucose and oleic acid, along with high energy contents (starch, fats, sugar and protein). They are rich in minerals, such as phosphorus and potassium, calcium, magnesium and iron necessary for bones, tissues repair, muscles, the blood stream and for body growth development. Consuming tiger nut can cure diarrhea and flatulence, control colon cancer and heart attacks among others (Bamishaiye, 2011)

Cheese have a long history in human diet (walther et al, 2008). In countries with developed dairy industry and some developing countries, cheese occupies an important position in the residents dietary structure. (Kahkashan et al, 2011).

A lot of research work has been carried out on cheese production. Olorunmisomo and Ikpinyang (2012) research on the chemical composition, sensory properties and yield of soft cheese precipitated with different coagulants while Bergamaschi et al (2016) reported cheese making in highland pastures. Milk technological properties, cream cheese and ricotta yields, milk nutrients: recovery and products composition. Cheese technology, compositional, physical and biofunctional properties was reported on an article on "foods" by Golfo (2019) and physic-chemical and rheological properties of prato cheese during ripening was reported by Bruno et al (2001). Ayeni et al (2014) researched into the production of wara cheese from locally sourced coagulants and its nutritional evaluation. Shirashoji and Lugey (2018) studied the effect of ph on the textural properties and meltability of pasteurized process cheese made with different types of emulsifying salts. However, there is a dearth inferus of research work involving plant milk in the production

of cheese. Therefore, this study is aimed at producing cheese from plant milk sources as a means of reducing over dependence on animal milk sources vis-à-vis its nutritional composition.

MATERIALS AND METHODS

Sources of Materials

Raw milk was sourced from fresh whole cow milk through hand milking from white Fulani cows in Sabo area of Fulani settlement, Ilaro, Ogun State, Nigeria. Diseased free soybeans and tiger nuts were purchased from a local market also in Ilaro while rennet tablets. were bought from a reputable store with in Ilaro.

Preparation of Soymilk

Soymilk was obtained using the method describe by Tijani (2014). Soybeans seeds were sorted to remove foreign and bad seeds, then roasted for about 3minutes to get rid of the beany aroma (smell) washed and soaked overnight in a lot of water to cover the beans. The soaked soybeans were diluted and 500mls of water was added to 283g of soybeans and blended for about 4minutes to obtain a fine filterate. This was repeated several times to achieve the required amount of the soymilk

Preparation Of Tiger Nut Milk

Fresh tiger nuts were sorted to remove diseased nuts and other foreign materials. The tiger nuts were then washed, soaked in water over night with 50ml water added to 283g of tiger nuts. The soaked tiger nuts were then blended with the aid of warring blender for about 4minutes, repeated three times in order to obtain maximum amount of the tiger nut milk. The blended tiger nut was filtered to separate the filtrate from the mash. The filtrate (milk) obtained was then stored in a stainless bowl, placed in a refrigerator.

Procedure For Preparation Of Cheese

Preparation of cheese using different ratios of cow milk, soymilk and tiger nut milk was done with 100% cow milk cheese as control using the method described by Tijani (2014). Rennet tablet was dissolved into $^{1}/_{16}$ cup of water, stirred and set aside. A quarter of 1½ teaspoons of citric acid was mixed into 1 cup of cool water until dissolved and then set aside. One litre of milk (cow milk and or tiger nut milk and/or soy milk) was poured into a pot and both the citric acid and rennet solution was poured into it and stirred vigorously. The milk was heated to 43.3ºC while stirring and after 10minutes, the curds were formed, drained with cheese (removing the whey).

Milk formulation for cheese production

815 - 100% cow milk (control)

523 - 50% cow milk, 50% soy milk

745 - 50% cow milk, 45% soy milk and 5% tiger nut milk

859 - 50% cow milk, 40% soy milk and 10% tiger nut milk

757 - 50% cow milk, 35% soy milk and 15% tiger nut milk

589 - 50% cow milk, 30% soy milk and 20% tiger nut milk

464 - 50% cow milk, 25% soy milk and 25% tiger nut milk

ANALYSIS

MOISTURE CONTENT DETERMINATION

The moisture content of the sample was determined using standard method according to (AOAC 1990).

Two (2) grams of each of the samples was weighed out with an analytical balance into dried, cooled and weighed dish in each case. The samples in the dishes were then put into a moisture extraction oven set at 105ºC and allowed to dry for 3hours when this time elapsed, the samples were then transferred into a dessicator with a laboratory troy and then allowed to cool for about 20minutes. They were thereafter weighed again and their respective weights recorded accordingly. These processes were repeated for each sample until a constant weight was obtained in each case. The difference in weight was calculated as a percentage a of the original sample.

$$\% \text{ Moisture} = \frac{\text{loss in weight due to drying} \times 100}{\text{Weight of sample taken} \quad 1}$$

$$= \frac{W2 - W3 \times 100}{W2 - W1 \quad 1}$$

Moisture (%) = Initial weight (g) final weight (g) x 100

Sample weight (g) 1

CRUDE PROTEIN DETERMINATION

Protein is the major compound containing Nitrogen. Nitrogen is used as an index of the protein termed 'Crude Protein' as distinct from true protein (AOAC, 2000) Kjeldahl method is the most reliable for insoluble food stuff.

Half a gram (0.5g) of each of the samples was mixed with 10ml of concentrated H_2SO4 acid in a Kjeldahl digestion flask. A tablet of the selenium catalyst was added to each of the samples which were then digested (heated) inside a fume cupboard until a clear solution was obtained in a separate flask in each case. Also, a blank was made by digesting the above reagents without any sample in it. Then, all the digests were carefully transferred into a 100ml volumetric flask in each case and were made up with distilled water. A 100ml portion of each digest was mixed with equal volume of 45% NaOH solutions in a Kjeldahl distilling unit. The resulted mixtures were each distilled and the distillates collected in each case into 10ml of 4% boric acid solution containing three drops of mixed indicators (bromocresol green and methyl red). A total of 50ml of each distillates was obtained and titrated with 0.02 mola H_2SO4 solutions. Titration was done from the initial green color to a deep red end-point. The nitrogen contents of each sample were **calculated thus; (AOAC, 1990).**

% Nitrogen = Volume of acid Hcl used x 0.0014 x 100 x 100

Weight of sample 10 1

Note 1ml of 0.1ml Hcl = 0.0014gN

Crude Protein = % Nitrogen x 6.25%

CRUDE FAT DETERMINATION

Two hundred and fifty milliliters of boiling flasks were washed with water, dried in an oven set at 105^{o}c for 25minutes, cooled in a desiccators and then used for each sample. The flasks were firstly labeled, weighed with a weighing balance and then filled with 200ml of petroleum ether in each case. Then, five grams of each of the samples was weighed out into a correspondingly labeled thimble. The extraction thimbles were in each case tightly plugged with cotton wool. The soxchlet apparatus was then assembled and allowed to reflux for 6hours. Thereafter, the thimble was removed and the petroleum either was collected in each case in the top of the container in the set up and drained into another container for re-use. The flasks were then removed in each case and dried in an oven at 105^{o}c for 1hour. After drying, they were placed in a desiccator where they cooled for about 20minutes and thereafter weighted. The percentage fat content was calculated for each sample thus: (AOAC, 1990)

Crude fat (%) = initial weight(g) – weight after extraction(g) x 100

Sample weight (g) 1

ASH CONTENT DETERMINATION

Two (2) grams of each of the samples was weighed out using an analytical balance into a dried, cooled and weighed crucible in each case. The samples were then charred by placing them on a Bunsen flame inside a fume cupboard to drive off most of the smoke for 30minutes. The samples were then transferred into a pre-heated furnace at 550^{o}C with a laboratory tong. They were allowed to stay in the furnace for 3hours until a white or light grey ash resulted. Samples that remained black or dark in color after this time had elapsed were moisture with small amount of water to dissolve salts, dried in an oven and then the ashing processes repeated again. After ashing, the crucibles were then transferred into a desiccators with a laboratory tong after cooling they were each weighed again and recorded accordingly (AOAC, 1990).

ASH (%) = Weight of crucible with ash(g) x 100

Weight of crucible with sample (g)

CRUDE FIBRE DETERMINATION

Five grains (5g) of each of the samples were used in this determination. The samples were each boiled in 500ml flask containing 200ml of 1.25% H_2SO4 solution under reflux for 30minutes. When this time elapsed, the samples were washed with several portions of hot boiling water using a two-fold muslin cloth to trap the residual particles. The residual particles in each case were carefully transferred qualitatively back to the flasks and 200ml of 1.25% NaOH solution was then added into each flask. Again, the samples were boiled for 30minutes and washed as before with hot water. Then, they were each carefully transferred into a weighed crucible and then dried in an oven set at 105^{o}c for 3hours. The dried samples were then put into desiccate where they cooled for about 20minutes before being weighed again. They were then put into a muffle furnance set at 550^{o}C for 2hours (until ashed).

Finally, they were cooled in desiccators and weighed again. The crude fiber content for each sample was calculated thus (AOAC, 1990).

Crude fibre(5)=weight residue with crucible(g)–wtofash with crucible x 100

Weight of fat free sample (g) 1

CARBOHYDRATE CONTENT DETERMINATION

The carbohydrate content was calculated by deducting the sum of the values for moisture, crude protein, crude fat, crude fibre and ash in 100 (AOAC, 1990).

DETERMINATION OF TOTAL SOLUBLE SOLIDS (TSS)

A drop of the sample was placed on the prism of the refract meter and the percentage of dry substance in it was read directly

DETERMINATION OF TITRATABLE ACIDITY

AOAC (1990) method was used to estimate the titratable acidity of the cheese samples. About 1g of each cheese sample was mixed with warm water and volume was made up to 10ml in 100ml conical flask. Each sample was shaken vigorously and filtered. The filtrate was titrated with 0.1 N NaoH using phenolphthalein as indicator. Percentage acidity was calculated by using the following expression.

Titratable acidity % = 0.0090 x volume of NaoH used x 100/weight of the sample.

DETERMINATION OF pH

About 20g of cheese sample was blended with 12ml water to prepare the cheese slurry and pH was measured by a digital pH meter (model CPH – 102, table top) after calibrating it with fresh standard buffer solutions of pH 4.0 and 7.0 (ong et al, 2007).

SENSORY ANALYSIS

The cheese samples were subjected to sensory evaluation using a 9 point Hedonic scale. Forty semi-trained panelists drawn from both the staff and students of the Federal Polytechnic, Ilaro, Ogun State Nigeria who were familiar with cheese were selected. The cheese samples were assessed by panelists for appearance, taste, texture, aroma and overall acceptability.

RESULTS AND DISCUSSION

TABLE 1: PROXIMATE COMPOSITION OF SOY-TIGER NUT MILK CHEESE (%)

SAMPLE	MOISTURE	PROTEIN	FAT	ASH	FIBRE	CHO
815	61.34±0.01	18.14±0.04	8.46±0.14	2.01±0.12	0.61±0.01	8.81±0.11
523	62.15±0.21	18.01±0.18	8.78±0.17	1.91±0.04	0.79±0.12	9.54±0.12
745	62.75±0.14	17.68±0.16	9.12±0.21	1.90±0.13	0.81±0.09	9.65±0.04
859	63.26±0.15	16.91±0.13	9.01±0.11	1.89±0.04	0.82±0.01	9.78±0.15
757	63.78±0.16	15.89±0.01	9.64±0.14	1.81±0.24	0.89±0.11	9.88±0.20
589	64.01±0.02	15.22±0.11	10.12±0.17	1.85±0.14	0.91±0.19	9.84±0.01
468	65.56±0.12	14.08±0.19	10.91±0.28	0.98±0.24	0.94±0.15	10.02±0.31

The values are expressed s the mean of three replicate samples

Milk formulation for cheese production

815 - 100% cow milk (control)

523 - 50% cow milk, 50% soy milk

745 - 50% cow milk, 45% soy milk and 5% tiger nut milk

859 - 50% cow milk, 40% soy milk and 10% tiger nut milk

757 - 50% cow milk, 35% soy milk and 15% tiger nut milk

589 - 50% cow milk, 30% soy milk and 20% tiger nut milk

464 - 50% cow milk, 25% soy milk and 25% tiger nut milk

Discussion

Proximate Composition

Table 1: Shows the proximate composition of soy-tiger nut milk cheese. The moisture contents obtained varied from 61.34±0.01% to 64.56%±0.12%. The moisture contents values were within the range obtained by (Balogun, M.A et al 2019). Aworh and Akinniyi, 1989 highlighted that moisture content contributes significantly to the textural properties of food samples. The moisture contents also agreed with what Orhevba, B.A and Taiwo, A.B obtained.

Adegoke, et al 1992 reported that the higher moisture content could favour the growth and proliferation of microorganisms and thus reducing the shelf life of cheese. The high moisture values of the cheese samples may also be attributed to the hydrophilic nature of soy protein.

The protein contents of the various samples were similar to the one obtained by Balogun, M.A et al 2019 and lower than the value of 45.3% reported by Johnson et al (2001). The protein content ranged from 14.08±19% to 18.14±0.4%. The nutritional value of soy protein is good, although the quality is not quite as high as some animal protein. The fat contents of the samples obtained ranged from 8.46±0.14% to 10.91±0.28%. These results agreed with what several authors established (Balogun et al, 2019 and Orhevba et al 2016). It was established by Belewu and Belewu, 2007 that Tiger nut milk showed higher fat content compared to soy milk. This might be the reason why the increase in fat contents of the samples with increasing levels of tiger nut milk.

The Ash contents ranged from 0.98±0.24% to 2.01±0.12% were obtained for all the samples. These values agreed with the results obtained by Balogun et al 2019. Ash content represents the total minerals content in foods. This indicates presence of minerals. It also plays an important role from the nutritional point of view. Fibre is made up of the indigestible parts or compounds of plants, which pass relatively unchanged throughout stomach and intestine. The main role of fibre is to keep the digestive system healthy. The fiber contents for call the samples ranged from 0.61±0.01% to 0.94±0.15%. Balogun et al 2019, reported the fiber contents of soy-tiger nut cheese in the range of 0.73±01% to 0.86±0.2%. The soy-tiger nut cheese obtained was in the range as it was reported. The carbohydrate contents ranged from 8.81±0.11% to 10.02±0.31% were obtained.

TABLE 2: TOTAL SOLIDS, pH AND TITRABLE ACIDITY OF SOY-TIGER NUT CHEESE

Samples	Total soluble solids (%)	pH	Titrable Acidity (5 lactic acid)
815	14.80±0.12	6.12±0.01	0.36±0.31
523	14.21±0.41	6.21±0.12	0.35±0.02
745	13.50±0.22	6.30±0.24	0.30±0.21
859	12.68±0.02	6.46±0.02	0.28±0.01
757	12.21±0.40	6.60±0.13	0.27±0.25
589	11.66±0.29	6.71±0.14	0.24±0.13
464	10.22±0.01	6.89±0.12	0.22±0.11

The values are expressed as the mean of three replicate samples

The pH and Titrable acidity of the soy-tiger nut cheese obtained ranged from 6.12±0.01 to 6.89±0.12 and 0.22±0.01 and 0.36±0.31 respectively while arise, et al, 2019, found values respectively, ranging from 6.45±0.70 to 6.90±0.70 for pH and 0.23±0.00% to 0.33±0.00% ad titrable acidity being in agreement with the results obtained in this project. As the pH increased, the titrable acidity decreased. pH is a measurement of the concentration of hydrogen ion while the titrable acidity is also a measurement of the buffer capacity of the milk. However, total soluble solids recorded in this present work ranged from 10.22±0.01 to 14.80±0.12. The total solids in cheese depend on the ability of the coagulant to precipitate the protein and fat in the milk. These results agreed with the work of Salma M. Siddiq et al 2016.

TABLE 3: SENSORY CHARACTERISTICS OF SOY-TIGER NUT CHEESE

Samples	Appearance	Taste	Texture	Aroma	Overall Acceptability
815	7.50±0.42	7.40±0.10	7.10±0.34	7.00±0.21	7.60±0.10
523	6.30±0.20	6.10±0.24	6.30±0.44	6.40±0.21	6.40±0.54
745	6.50±0.43	6.30±0.30	6.40±0.21	6.50±0.10	6.54±0.30
859	6.21±0.20	5.90±0.03	6.01±0.10	6.20±0.21	6.0±0.20
757	5.00±0.10	5.40±0.01	5.80±0.40	6.10±0.34	5.6±0.14
589	4.90±0.11	4.90±0.20	5.00±0.40	5.50±0.30	5.0±0.23
464	4.50±0.20	4.80±0.22	4.60±0.13	5.20±0.21	4.50±0.44

Table 3 shows the sensory characteristics of soy-tiger-nut cheese. In this study, the texture of the cheese samples was significantly ($P \leq 0.05$) affected. The control (sample 815) recorded the highest overall acceptability (7.60±0.10) followed by sample 745. Sample 464 was the lowest in score (4.50±0.44). The high moisture content of sample 464 attributed to its rejection.

CONCLUSION

The results of this study demonstrated that the addition of soy milk and tiger-nut milk with the whole milk did not necessarily have negative effect on the nutritional quality of the developed cheese products. It was also revealed that the sensory attributes of cheese samples produced from cow milk with

added soy milk and tiger-nut milk showed significant improvement. In addition to these, incorporation of soy milk and tiger-nut milk in cheese production resulted in cost saving and improvement of the nutritional value.

ACKNOWLEDGEMENT

The technical and financial support of the Federal Polytechnic, Ilaro, Ogun State, Nigeria and the Tertiary Education Trust Fund are acknowledged.

REFERENCES

Adegoke, G.O, Nse, E.N and Akanni, A.O (1992). Effects of heat, processing time and pH on the micro flora; aflatoxin content and storability of wara, a soft white cheese Die Nahrung, 36(3), 259-264

AOAC (1990) official methods of Analysis. Association of Analytical chemists, Washington, D.C

Aworh, O and Akinniyi, O (1989) consumer acceptability and microbial quality of soy-warankasi. A Nigeria soft cheese made from a mixture of soymilk and cow milk. Nigerian food Journal 7:50-56.

Ayeni, O. Augustine, Adeeyo A. Opeyemi, Ore Segun M. Oyinlola (2014). The production of Wara cheese from locally sourced coagulants and its nutritional evaluation. Journal of Environmental Science, Toxicology and Food Technology; volume 8, issue 10 ver 11 pp 55-57.

Balogun, M.A., Oyeyinka, S.A, Kolawole,, F.L, Joseph, J.K and Olajobi, G.E (2019). Chemical composition and sensory properties of soy-tiger-nut cheese. Ceylon Journal of science 48(4): 353 – 358

Bamishaiye, E.I (2011) Tiger nut, its derivatives and benefit. http:www. Africanschorlarlyscience/ajfandonline.com.

Belewu M.A. and Belewu K.Y. (2007). Comparative physico-chemical Evaluation of Tiger-nut, soybean and coconut milk sources.

Bergamasehi, C. Cipolat-Gotet, G. Stocco, C. Valorz, I. Bazzoli, E. Ramanzin, and Bittante, G. Cheese making in highland pastures: milk technological properties, cream, cheese and ricotta yields, milk nutrients recovery, and products composition. J. Dairy Sci. 99:9631-9646.

Bruno de souse Carvalho, Marco Antonio Pereira da Silva, Jessica Leal Freitas esouza, Nubia Ferreira Viera, Geovana Rocha Placido, Edmar Soares Nicolau, Moacir Evandro Lage and Rodrigo Bauduino Soares Neves (2015). Physic-chemical and rheological properties of Prato cheese during ripening.*African Journal of Biotechnology vol.14 (24), pp.2008-2034*

Dairy Science Technology, 88:389-405

El-siddig, E.E, Abdelqadir, W.S, Kabeir, B.M and Ishag, R.H (2018). Milk clothing Efficiency of extracts from different parts of Sudanese Moringa Olefera.*International Journal of Advanced Research in Biological Sciences. Volume 5 issue 9*

Golfo Moatsou, (2019). Cheese: Technology, compositional, physical and biofunctional properties: A special issue Foods 2019, 8, 512

International Journal of Agriculture and Biology vol.9, No.5, pp 785-787

Johnson, M.E, Chen, C.M and Jaeggi J.J (2001). Effect of rennet Coagulation time on composition yield and quality of reduced fat cheddar cheese. J. Dairy Sci. 84: 1027-1023

Kahkashan Perveen, Badriah alabdulKarim and Shaista Arzoo (2011). Effect of temperature on shelf life, chemical and microbial properties of cream cheese. *African Journal of Biotechnology vol. 10(74), pp.16929-16936*

Lu,Y, Shirashoji and Lucey, J.A (2008). Effect of pH on the Tectural Properties and meltability of pasteurized process cheese made with different types of emulsifying salt. *Journal of Food Science vol. 73, Nr 8 pp E363-E369*

Mason D (2005) Tiger-nuts http//www.nvswk.org.uk/growing-showvegetables/tigernut.php

National Dairy Council (2000) Definition and classification of cheese managed by daira management, inc Rosemont, IL 60018-5616.

Nir, B (2004). Modern Technology of milk processing and Dairy products (2nd Edition) National Institute Industrial Research, pp28

Olorunnisomo,, O.A and Ikpinyang, E.A (2012) chemical composition, sensory properties and yield of soft cheese precipitated with different coagulants. *Trop. Anim. Prod. Invest. 15(1): 15-18*

Ong. L, Henriksson, A and Shah, N.P (2007) Proteolytic pattern and organic acid profiles of probiotic products *Int. Dairy J. 5:877-903*

Orhevba, B.A and Taiwo, A.D (2016). Comparative assessment of 'Wara' (Local cheese) produced using three natural additives as coagulants *Research Journal of Food Science and Nutrition: Volume 1(3), pages 49-55*

Rinaldoni, A.N Campderros, M.E and Perez Padillah (2014) Physico-Chemical and Sensory properties of yogurt from ultrafritrated soy-milk concentrate added with insulin. Food science Technology, 45(2), 142-147

Salma M. Siddig, Abdel Monein E. Sulieman, Zakaria a. Salih, Abdelmuhsin A, Abdelmushsin (2016). Quality characteristics of white cheese (Jibna-beida) produced using camel milk and mixture of camel milk and cow milk internationao Journal of Food Science and Nutrition Engineering 6(3) 49-54.

Scott, R (1986). Cheese making practice, 2nd Edition, Elservier Applied Science publisher, London, pp.529

Talib, A.M Abubakar, M.M, Jideani, I.A and Hassan A, (2009) use of Jiben seeds etract to manufacture soft white cheese A.M J.Appl. Sci 6:551-554.

Tijani F, (2014) Evaluation of the potential of adding Tiger-nut milk and soy-milk into cheese making. University of Ghana, Digital collection. Thesis (Mphil)

Walther; B, Zchmid a, Sieber, R and Wehmuller, K (2008) Cheese in nutrition and health.