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# Chemical Composition, Sensory Evaluation, Starter Activity and Rheological Properties of Cow and Coconut Milk

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## ABSTRACT

The aims of this investigation were (1) to study the influence of mixing various levels of coconut milk to cow milk on the chemical composition, sensory evaluation and rheological properties, (2) to determine the activity of classic yoghurt and ABT cultures in the previously mentioned milk. Acidity, $E_h$, total nitrogen and ash levels of cow milk were slightly higher than those of coconut milk. On the contrary, total solids and fat values highly raised in the coconut milk than in the cow milk. Coconut milk obtained the greatest scores for color, appearance, body and texture; and the lowest scores of flavour. Increasing of acidity and $E_h$ values within fermentation was lower in coconut milk than in cow milk. Incorporation of coconut milk with cow milk reduced the development of acidity and $E_h$ in mixed milk. Blinding of different levels of coconut milk with cow milk lowered the curd tension values. Syneresis values of cow and coconut milk mixtures were higher than that of cow milk only.

## INTRODUCTION

Recently, non-dairy milk types, such as soymilk, coconut milk, almonds milk, rice milk and oat milk, have been an increased demand of the consumers due to their high functional properties. The cereal and grain milks also do not contain cholesterol or lactose; hence, these milk types are preferred by someone ,who are vegetarians, who have special diet or are lactose intolerant (Durand, *et al.*, 2002).

Although oil recovery remains the major concern in the coconut industry, there appears to be of anincreasing demand for the aqueous extract of the solid coconut endosperm, commonly called coconut milk, for use in the home and in the food industry. It has been estimated that 25% of the world's output of coconuts is consumed as coconut milk (Gwee, 1988).

Coconut milk is the liquid obtained by manual or mechanical extraction of comminuted coconut meat, with or without water. The composition of coconut milk depends on the amount of water used for the extraction, affecting significantly moisture and fat content.

Therefore, the objective of this study was to investigate the chemical composition, sensory evaluation, rheological properties and starter activity of cow milk mixed with various amounts of coconut milk.

## MATERIALS AND METHODS

Raw cow milk was bought from private farm in Damiette Governorate, Egypt. Coconut (*Cocos nucifera* L) and honey were also purchased from supermarket in Damiette Governorate. A commercial classic yoghurt starter containing *Streptococcus thermophillus* and *Lactobacillus delbrueckii* subsp. *bulgaricus* (1:1) and ABT-5 culture which consists of *S. thermophiles, Lactobacillus acidophilus + B. bifidum* (Chr. Hansen's Lab A/S Copenhagen, Denmark) were used. Starter cultures were in freeze-dried direct-to-vat set form and stored at –18°C until used.

Coconut seed was cracked manually, and the coconut meat removed with sharp knife. The brown part of the coconut meat was gently scraped off, cut into smaller pieces to enhance quicker blending. Two hundred grams of white coconut meat were blended with one liter of distilled water. The slurry obtained was further diluted with 1 liter of distilled water. It was then sieved with double layers of cheese cloth. The filtrate obtained is coconut milk Kolapo and Olubamiwa (2012).

Total solids, fat, total nitrogen and ash contents of samples were determined according to (AOAC, 2000). Titratable acidity in terms of % lactic acid was measured by titrating 10g of sample mixed with 10ml of boiling distilled water against 0.1 N NaOH using a 0.5% phenolphthalein indicator to an end point of faint pink color. pH of the sample was measured at 17 to 20°C using a pH meter (Corning pH/ion analyzer 350, Corning, NY) after calibration with standard buffers (pH 4.0 and 7.0). Redox potential was measured with a platinum electrode [model P14805-SC-DPAS-K8S/325; Ingold (now Mettler Toledo), Urdorf, Switzerland] connected to a pH meter (model H 18418; Hanna Instruments, Padova, Italy).

Samples of milk were organoleptically scored by the staff of the Dairy Department, Faculty of Agriculture, Damietta University. The score points were 50 for flavour, 35 for body and texture and 15 for colour and appearance, which give a total score of 100 points.

**Rheological Analyses:**

The curd tension was determined using the method of Chandrasekhara *et al.,* (1957) whereas the susceptibility to syneresis (STS) was measured as given by Kpodo *et al.,* (2014).

The obtained results were statistically analyzed using a software package (SAS, 1991) based on analysis of variance. When F-test was significant, least significant difference (LSD) was calculated according to Duncan (1955) for the comparison between means.

## RESULTS AND DISCUSSION

Data of Table 1 show the impact of adding 25, 50 and 75% coconut milk to cow milk on acidity, pH, $E_h$, TS, fat, total protein and ash contents. The basic difference between coconut milk and cow milk is that one is derived from a plant and the others from an animal.

Acidity and $E_h$ levels of cow's milk were slightly higher than those of coconut milk. Therefore, blinding of different amounts of cow's milk with coconut milk increased acidity and $E_h$ values of the resultant milk. Samples A (cow's milk), B (coconut milk) and D (50% cow milk and 50% coconut milk) had 0.18, 0.16 and 0.17% acidity values respectively. Values of pH of various treatments possessed the opposite trend of acidity and $E_h$.

Considerable content of TS (almost one and a half) and fat (almost three times) was detected in the coconut milk than in the cow's milk. On the contrary, total nitrogen and ash contents of the former were lower than the latter. Cow's and coconut milk contained 13.92 and 18.26% of total solids, respectively. Mixing of coconut milk with cow's milk increased TS and fat values and decreased total nitrogen and ash contents of the resulted mixtures. These results are in agreement with Ladokun and Oni (2014), who found that coconut milk contains higher total solids and fat and lower crude protein and ash than cow and goat milk. The ash content which was highest in goat milk and lowest in coconut milk could be due to the salt lick activities done by the herbivores (Aworh and Akinniyi, 1989).

Chemical composition of coconut milk were, generally, within the ranges described by Arumughan *et al.,* (1993), while were lower than recommended by Law *et al.,* (2009). Arumughan *et al.,* (1993), showed that total solids, fat and ash contents of coconut milk produced in Singapore were 15.60, 11.00 and 0.70% respectively while Law *et al.,* (2009) cleared that total solids, fat and ash values of raw coconut milk were 33.89, 24.75 and 0.81% respectively. Generally, the variation in coconut to water ratio used for coconut milk extraction affects the coconut milk composition.

**Table 1. Chemical composition of cow and coconut milk**

| Treatments | Acidity (%) | pH values | $E_h$ (mV*) | TS (%) | Fat (%) | TN (%) | Ash (%) |
|---|---|---|---|---|---|---|---|
| A | 0.18$^a$ | 6.60$^a$ | 47.2$^a$ | 13.92$^b$ | 3.4$^d$ | 0.613$^a$ | 0.71$^a$ |
| B | 0.16$^{ab}$ | 6.70$^a$ | 37.1$^c$ | 18.26$^a$ | 9.0$^a$ | 0.424$^{ab}$ | 0.60$^a$ |
| C | 0.18$^a$ | 6.62$^a$ | 47.3$^a$ | 15.41$^b$ | 5.2$^c$ | 0.589$^a$ | 0.68$^a$ |
| D | 0.17$^a$ | 6.65$^a$ | 42.5$^b$ | 16.30$^{ab}$ | 6.6$^b$ | 0.526$^a$ | 0.65$^a$ |
| E | 0.16$^{ab}$ | 6.69$^a$ | 37.4$^c$ | 17.66$^a$ | 7.4$^b$ | 0.479$^{ab}$ | 0.64$^a$ |

***mV: millivolts**
**A: Cow milk; B: Coconut milk; C: 75 % Cow milk + 25 % Coconut milk**
**D: 50 % Cow milk + 50 % Coconut milk; E: 25 % Cow milk + 75 % Coconut milk**

The organoleptic properties of cow and coconut milk and their mixtures are presented in Table 2. Generally, all samples were acceptable by the sensory evaluation panels, but the acceptability rates strongly varied. Because of bright white color favored for Egyptian consumers, coconut milk recorded the highest grades for color and appearance. On the other side, increasing of total solids contents of coconut milk resulted in higher body and texture scores, compared with cow's milk. On the contrary, coconut milk obtained the lowest scores of flavour. Coconut taste/flavour undoubtedly is the principal reason for the declining of coconut milk flavour scores. Blinding of coconut milk with cow's milk improved the flavour evaluation scores of the former and also improved the color, appearance, body and texture grades of the latter. Sample of 50% cow milk + 50% coconut milk (D) gained the highest total sensory evaluation scores for mixtures of cow and coconut milk.

**Table 2: Sensory evaluation scores of cow and coconut milk**

| Treatments | Color & Appearance (15) | Body& Texture (35) | Flavor (50) | Total (100) |
|---|---|---|---|---|
| A | 12.3$^b$ | 31.6$^b$ | 47.6$^a$ | 91.5$^a$ |
| B | 14.6$^a$ | 33.9$^a$ | 44.0$^c$ | 92.5$^a$ |
| C | 12.3$^b$ | 32.0$^b$ | 46.5$^{ab}$ | 90.8$^b$ |
| D | 13.3$^{ab}$ | 32.9$^{ab}$ | 45.4$^b$ | 91.6$^a$ |
| E | 14.0$^a$ | 33.4$^a$ | 44.1$^c$ | 91.5$^a$ |

For measurement the effect of blinding various concentrations of coconut milk with cow milk on starter activity, the changes in acidity, pH and $E_h$ values of milk inoculated with classic yogurt and ABT cultures were tested at 30 min intervals. Fermentation was stopped after 180 min. Findings were cleared in Fig. 1-6.

A gradual increase in acidity and $E_h$ levels in different milk treatments was found through fermentation time. The highest increasing was recorded after 90 min. Both acidity values and the development of acidity rates during incubation time were slightly higher in milk inoculated with classic starter as compared with milk inoculated with ABT culture. These results are agreement with that ststed by Damin *et al.,* (2008), who showed that milk fermented with *Streptococcus thermophilus* and *Bifidobacterium lactis* had the lowest post acidification. This behavior could be explained by the limited capacity of bifidobacterium to produce organic acids at low temperatures (Mattila-Sandholm *et al.,* 2002) or by the highly proteolytic activity of normal starter which could produce higher amount of proteinase enzymes which breakdown milk protein into small peptides that are used as a nitrogen source during the growth of the cells in milk (Thomas and Pritchard, 1987).

Increasing of acidity and $E_h$ during fermentation was lower in coconut milk than those of cow milk. Incorporation of coconut milk with cow milk reduced rising of acidity and $E_h$ in mixed milk. Similar outcomes were reported by Ladokun and Oni (2014), who found that the gradual decrease in the pH was higher in cow or goat milk than that of coconut milk.

**Rheological characteristics of fermented cow and coconut milk:**

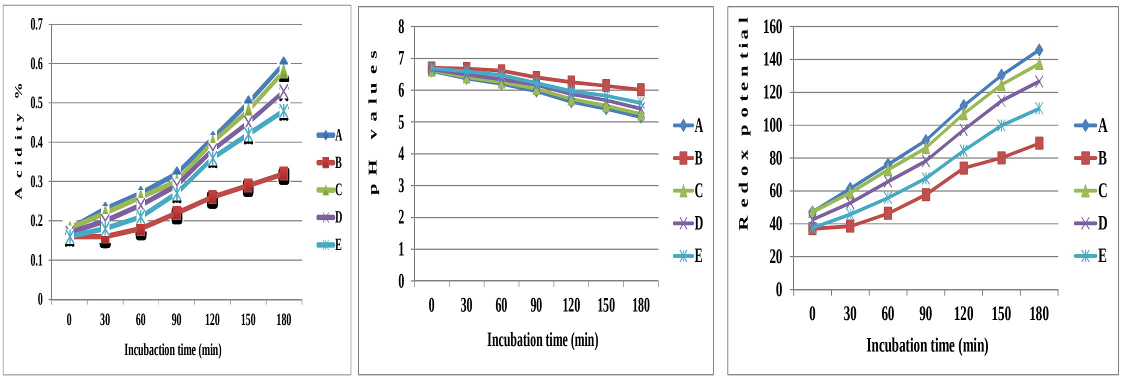
The effect of utilization different starters and mixing of coconut milk with cow milk on curd tension is presented in Table 3.

However, inoculation of coconut milk with classic yoghurt or ABT starter (samples B and G respectively) and incubation at the appropriate temperature for more than four hours but milk failed in curd formation. An increase in acidity could be observed. In contrast, yoghurt successfully made from cow milk or mixture of cow and coconut milk. On the whole, utilization of ABT culture in yoghurt production lowered curd tension levels comparing with that made by classic starter. These results suggest that the curd produced by ABT culture was softer than that formed by classic starter. These findings are similar to that showed by Ismail (2015).

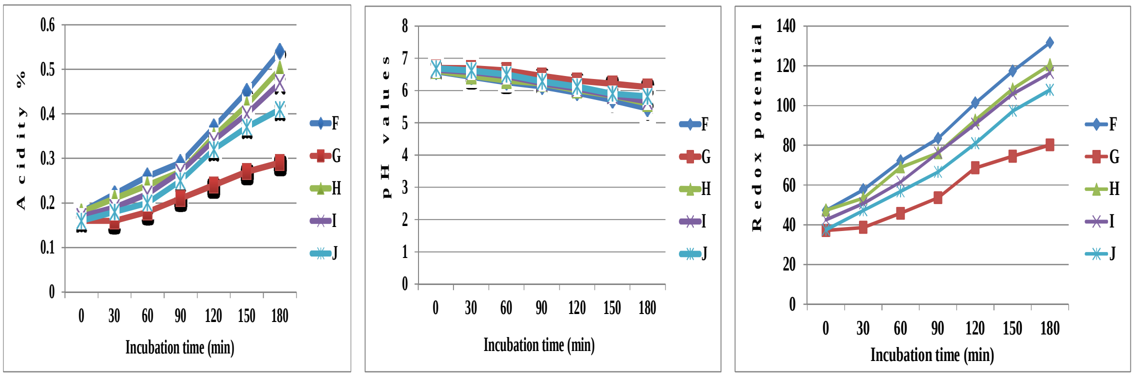
Blinding of various amounts of coconut milk with cow milk significantly (P<0.05) decreased the curd tension values. The decreasing rates were proportional to the amount added of coconut milk.

The results of syneresis stated in Table 3 showed that samples coagulated with ABT starter had higher values of susceptibility to syneresis (STS) than that coagulated by classic culture. Susceptibility to syneresis values of fresh treatments A and F were 23.7 and 25.3% respectively. These results are similar to that found by Ammar *et al*., (2014), who cleared that there is a little increase of syneresis values with using of ABT culture in yoghurt production. However, Hussein (2010) stated that increased separation of whey was found from the infants' yoghurt-like fermented products (IYFP) made with traditional starter than that made with probiotic starter (ABT-2).

Concerning of the influence of milk type on STS, results in Table 3 cleared that values of STS of cow and coconut milk mixtures were higher than that of cow milk only. Also, the raising in the coconut milk mixed positively affected the STS values.




**Figures 1, 2 and 3. Changes in acidity, pH and $E_h$ within fermentation of cow and coconut milk and their mixtures (coagulation with classic yoghurt starter)**




**Figures 4, 5 and 6. Changes in acidity, pH and $E_h$ within fermentation of cow and coconut milk and their mixtures (coagulation with ABT starter)**

**Table 3. Effect of starter type on some rheological properties of cow and coconut milk and their mixtures**

| Treatments | Curd tension (gm) | Syneresis (%) |
|---|---|---|
| A | $40.90^{a}$ | $23.7^{g}$ |
| B | -- | -- |
| C | $37.33^{c}$ | $27.3^{e}$ |
| D | $30.35^{e}$ | $29.8^{d}$ |
| E | $20.02^{g}$ | $36.3^{b}$ |
| F | $38.84^{b}$ | $25.3^{f}$ |
| G | -- | -- |
| H | $34.63^{d}$ | $28.9^{d}$ |
| I | $27.97^{f}$ | $31.6^{c}$ |
| J | $18.69^{h}$ | $39.2^{a}$ |

[abcde] **Letters indicate significant differences between Yoghurt treatments**

**Coagulation with classic yoghurt starter**

A: Cow milk; B: Coconut milk; C: 75 % Cow milk + 25 % Coconut milk

D: 50 % Cow milk + 50 % Coconut milk; E: 25 % Cow milk + 75 % Coconut milk

**Coagulation with ABT starter**

F: Cow milk; G: Coconut milk; H: 75 % Cow milk + 25 % Coconut milk

I: 50 % Cow milk + 50 % Coconut milk; J: 25 % Cow milk + 75 % Coconut milk

## CONCLUSION

From the outcome obtained above, it is recommended with utilization of mixtures of 75% cow milk +25% coconut milk and 50% cow milk+ 50% coconut milk for yoghurt manufacturing.

## REFERENCES


Ammar, El-Tahra, M. A., Ismail, M. M., Khalil, A. E. and Eid, M. Z. (2014). Effect of supplementation with olive oil on some properties of bio-yoghurt. The Asia Journal of Applied Microbiology, 1(4): 66-77.

AOAC. (2000). Association of Official Analytical Chemists. Official Methods of Analysis. 17th ed, Washington, DC, USA.

Arumughan, C., Balachandran, C. and Sundaresan, A. (1993). Development of process for coconut cream on commercial scale. Journal of Food Science and Technology, India, 30:408-412.

Aworh, S. and Akinniyi, A. (1989). Proximate Analysis and Nutritional Component of Locally Produced Cheese. Nigerian Journal of Food Science and Technology, 9: 220-227.

Chandrasekhara, M. R., Bhagawan, R. K., Swaminathan, M., Subrahmanyan, V. (1957). The use of mammalian milk and processed milk foods in the feeding of infants. Indian J. Child. Health, D, 70L.

Damin, M. R., Minowa, E., Alcantara, M. R. and Oliveira, M. N. (2008), Effect of cold storage on culture viability and some rheological properties of fermented milk prepared with yoghurt and probiotic bacteria. J. Texture Studies, 39: 40–55.

Duncan, D. B. (1955). Multiple Range and Multiple F-test. Biometrics,11:1– 42.

Durand, A., Franks, G. V. and Hosken, R.W. (2002). Particle Sizes and Stability of UHT Bovine, Cereal and Grain milks. Food Hydrocolloids, 17: 671–678.

Gwee, C. N. (1988). New technologies open the passage into new usage of coconut milk product. In: Food Science and Technology in Industrial Development, vol. I (edited by S. Maneepun, P. Varangoon and B. Phithakpol). Pp. 157-162. Bangkok: Institute of Food Research and Product Development, Kasetsart University.

Hussein, G. A. M. (2010). Preparation of yoghurt and probiotic yoghurt- like fermented products for bottle-fed infants. Egyptian J. Dairy Sci., 38:171-182.

Ismail, M. M. (2015). Improvement of nutritional and healthy values of yoghurt by fortification with rutub date. Journal of Microbiology, Biotechnology and Food Science. 4 (5): 398-406.

Kolapo, A. L. and Olubamiwa, A. O. (2012). Effect of different concentrations of coconut milk on the chemical and sensory properties of soy-coconut milk based yoghurt. Food and Public Health, 2(4): 85-91.

Kpodo, K. F. M., Afoakwa, E. O., Amoa, B. B., Budu, A. S. and Saalia, F. K. (2014). Effect of Ingredient Variation on Microbial Acidification, Susceptibility to Syneresis, Water Holding Capacity and Viscosity of Soy-Peanut-Cow Milk Yoghurt. Journal of Nutritional Health & Food Engineering 1(2): 1-6.

Ladokun, O. and Oni, Sarah. (2014). Fermented milk products from different milk types. Food and Nutrition Sciences, 5:1228-1233.

Law, H. Y., Ong, C. I. Ab. Aziz, N. Taip, Farah S. and Muda, N. (2009). Preliminary work on coconut milk fouling deposits study, International Journal of Engineering & Technology, 9: 8-13.

Mattila-Sandholm, T.; Myllarinen, P.; Crittenden, R.; Mogensen, G.; Fonden, R. and Saarela, M. (2002). Technological challenges for future probiotic foods. Int. Dairy J. 12:173–182.

SAS (1991). SAS User's guide: statistics. SAS Inst, Inc, Cary, NC.

Thomas, T. D. and Pritchard. G. G. (1987). Proteolytic enzymes of dairy starter cultures. FEMS Microbiol. Rev. 46:245-268.


## التركيب الكيماوي والخواص الحسية والريولوجية ونشاط البادئ باللبن البقري ولبن جوز الهند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أجُري هذا البحث بغرض دراسة تأثير خلط كميات مختلفة من لبن جوز الهند مع اللبن البقري على التركيب الكيماوي والخواص الحسية والريولوجية ونشاط البادئ باللبن الخليط الناتج. وتشير النتائج إلي أرتفاع قيم الحموضة و $E_h$ والنتروجين الكلي والرماد باللبن البقري مقارنة بلبن جوز الهند، وعلى العكس احتوى لبن جوز الهند على قيم مرتفعة من المواد الصلبة والدهن عن تلك الموجودة باللبن البقري. وقد سجل لبن جوز الهند أعلى درجات التحكيم الحسي الخاصة باللون والمظهر والتركيب والقوام في حين أنخفضت به درجات الطعم والنكهة مقارنة بتلك الخاصة باللبن البقري. زيادة قيم الحموضة و $E_h$ أثناء عملية التخمر كانت منخفضة بلبن جوز الهند عن تلك المسجلة باللبن البقري. وقد أدى خلط لبن جوز الهند مع اللبن البقري إلي خفض درجات الزيادة في الحموضة باللبن الخليط الناتج أثناء عملية التخمر. كذلك أدى خلط لبن جوز الهند مع اللبن البقري إلي خفض قيم الجذب الخثري وزيادة قيم نزح الشرش وقد دلت النتائج على ان افضل نسب خلط كانت ٧٥ % لبن بقرى + 25 % لبن جوز هند و ٥٠ % لبن بقرى + ٥٠ % لبن جوز هند .