AG 23

Physiochemical and Preferences of Goat and Cow milk Products

Pisey Vong [1,4*], Sath Keo [2], Chim Chay [3], Mom Seng [1]

[1] Center for Livestock Development Studies, Royal University of Agriculture (RUA)
[2] Faculty of Veterinary Medicine, RUA
[3] Faculty of Agro-Industry, RUA
[4] University of Heng Samrin Tbongkhmum

*Corresponding Email: vpisey@rua.edu.kh

Abstract: A preference test was conducted to determine customers' preferences on goat milk and cow milk products. The objectives of the study were: (1) To enumerate microorganisms and physiochemical properties in goat and cow milk products, and (2) To determine the preferences of goat and cow milk products. Goat milk (GM) was purchased from abroad while Cow milk 1 (CM1) and Cow milk 2 (CM2) were produced locally and available on markets in Phnom Penh. Samples were undergone analyzed for PCA and Coliform bacteria counts prior to sensory evaluation. Basic milk contents such as fat, protein, lactose, solid non-fat (snf), total solid (TS), freezing point (FP), pH, Total Sugar Soluble (TSS), and titratable acidity (TA) were analyzed. The samples (approximately 15 ml each) were presented in uniform plastic cups and coded with random 2-digits numbers. These samples were evaluated for color, aroma, flavor, mouth feel and general acceptability by using a 9-point hedonic scale ranging from 1('dislike extremely to 9 ("like extremely). Drinking water and crackers were provided to panelists who were instructed to eat some crackers and rinse properly between testing. All panelists evaluated each sample monadically. The result shows that GM had 2.2% fat, 1.58% protein, 2.61% lactose, 4.53% SNF, 6.6% TS, -0.27^{o}C Freezing point, 8.6 ^{o}Brix and 0.17% TA. CM1 had 3.54% fat, 2.9% protein, 4.69% lactose, 8.27% SNF, 11.8% TS, -0.50^{0}C FP, 6.5 pH, 11.7 ^{0}Brix, and 0.24% TA. Similarly, for CM2 sample which had 3.55% fat, 3.34% protein, 4.16% lactose, 8.12% SNF, 11.75% TS, -0.47^{0}C FP, 6.61 pH, 13.25 ^{0}Brix, and 0.17% TA. However, milk physiochemical such as fat, protein, lactose, SNF, TS, and pH of cow milk samples were in range with literature reviews while these composition for GM, except pH, are much lower than literature reviews. Also, CM1 and CM2 had a bit lower FP than literature reviews while FP of GM were much lower. For bacterial count, there were none of harmful bacteria encountered for General Bacteria (PCA) and Coliform. The sensory evaluation was conducted with total of 143 panelists and 46.85% (67) were females. There were 4 types of panelists; 21 (15.39%) RUA lecturers and researchers, 106 (77.62%) RUA students, and 10 (7%) General customers. The score for aroma was not significant different among samples which ranges from 5.89 to 6.31. For color, there were significant differences among GM and CMs sample but no significant differences between CM1 and CM2 in which CM2 had the highest score of 6.79 then followed by CM1 (6.75) and GM (5.92). For flavor, there were significant differences among samples which is CM2 received highest core of 6.77 then followed by CM1 (6.01) and GM (5.18). The same preference for mouth feel, CM2 was rated highest score and GM was rated the lowest. There was significant difference between GM (5.76) and CM2 (6.65) by P<0.05 but there were no significant differences between GM and CM1 (P>0.05), and between CM1 and CM2 (P>0.05). For general acceptability, there were significant differences among samples (P=0.00) as CM2 was given highest score (6.92) then followed by CM1 (6.21) and GM (5.61). For products ranking, CM2 received the most 1st choice ranking by 51.75% and GM received the least as 19.58%. From the result of bacterial count, the three products are safe for consumers in term of no harmful bacteria encountered for PCA and Coliform. For sensory evaluation, goat milk had the least preference compared to cow milk samples. Moreover, the cow milk with basic milk components the same with CM2 was the most favorite milk for most panelists.

Key words: *Bacteria counts, milk compositions, goat milk, cow milk, Phnom Penh.*

Introduction

Goat milk is considered as another good complete food produced by goats, small ruminants, who require less feed and easier to handle than dairy cows. However, goat produces around 0.5 liter of milk per day to 2-4 Liter for specialized breed such as Saanen, Nubian, Alpine, LaMancha and Toggenburge (Peacock, 1996). Since human population gain every day, substitution of cow milk from other origins started to increase, like from buffalo, goat and mare. Goat milk become a topic for current studies may be attributed to the nutritional, health, and therapeutic benefit regarding to goat milk consumption (Robeiro et al. 2010). Goat milk has lower allergic potential compared to cow milk (Silanikoveet al. 2010) and this may due to better digestibility (Egypto et al. 2013) due to differences of amount and structure of whey protein (Albenzio and Santillo 2011) and the smaller size of fat globules (Attaie and Richter 2000).). By the way, the problem on acceptance of products from goat milk is their intense taste and aroma compared to cow's milk (Costa et al. 2016) cited by Dimitrellou et al., 2019. Therefore, the study on the physiochemical and preferences of goat and cow milk was conducted.

Objective

The research generally aimed to evaluate preferences of general customers on goat milk. Specifically, aimed to:

1. To enumerate microorganisms and physiochemical properties in goat and cow milk products.
2. To determine the preferences of cow and goat milk products.

Methodology

To obtain the objectives of the study, milk samples were subjected to laboratory analysis for microorganisms and physiochemical, then sensory evaluation was conducted with total of 143 panelists including lecturers, researcher, students, and general customers around RUA who were from 18 to 65 years old from September to November 2020.

Laboratory analysis

For basic milk composition such as fat, protein, lactose, total solid (TS), solid non fat (SNF), and freezing point were analyzed with MilkoScan™ Mars (FOSS-Denmark compliant with AOAC and IDF (International Dairy Federation). pH was analyzed using pH meter (LAQUA:pH meter F-71 Horiba 2016), TSS was analyzed by Refractometer (ATAGO, JP). Titratable Acid (TA) was performed according to AOAC method no. 947.05 (AOAC 1990). For Total Plate Count was performed followed Standard Pour Plate (AOAC method 966.23) and Coliform was performed followed the test method by Ludemann and Hyde 2015. Bacteria were counted at 24hr and 48hr.

Sensory Evaluation process

A preference test was carried out with the aim to evaluate sensory properties of milk samples. Three milk samples were used in the study; one Goat Milk (GM) and 2 local cow milk samples coded as Cow Milk 1 (CM 1) and Cow Milk 2 (CM 2). GM was purchased from abroad (UHT) and other two cow milk samples were produced locally in Cambodia from farm 1 and farm 2 purchased from supermarkets and company's vendor in PP as pasteurized type at the same day and same shelf life. The samples (approximately 15 ml each) were presented in uniform plastic cups and coded with random 2-digits numbers. Milk were conditioned to room temperature to allow a serving temperature that is above refrigeration temperature, as suggested by Hough et al. 1992 based on the regulation of the International Dairy Federation (IDF) Standard 99:180 Sensory Evaluation of Dairy Products. These samples were evaluated for color, aroma, mouth feel, flavor and general acceptability using a 9 -point hedonic scale ranging from 1('dislike extremely to 9 ("like extremely) (Meilgaard et al. 1991). Drinking water and crackers were provided to panelists who were instructed to eat some crackers and rinse properly between testing. All panelists evaluated each sample monadically.

Statistical analysis: Significance was established at P<0.05. All data were recorded in excel program and analyzed for statistical significance with ANOVA and Turkey 's Honest significant Difference (HSD) test in IBM SPSS version 21.

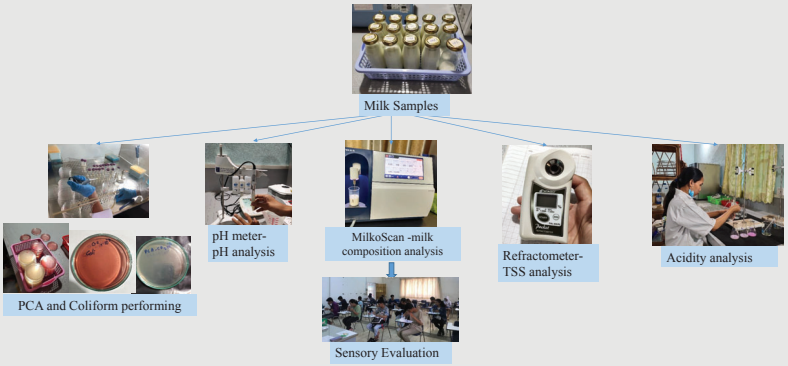

Figure 1. Lab Processes and Sensory Evaluation

Results and Discussion

In Table 1, GM sample had milk fat, protein, lactose, SNF, TS, FP and TSS much lower than literature reviews as mentioned by Kapadiya et al., 2016; Potocnik et al., 2011; Walstra et al., 2006; Ali 2006; Devandra et al., 1996. However, pH of GM (6.73) was similar report of Walstra et al., 2006 that normal milk pH range from 6.5 – 6.7 and TA of GM is a bit higher than literatures that stated that raw milk TA ranges from 0.12 to 0.15% but it may increase by age and protein as stated by Schmidt et al., 1996 and Dimitrellou et al., 2013 and Fabro et al. 2006). Our GM sample is a UHT type which is produced around 1 month before analysis happened.

Table 1 presents results on physiochemical of milk samples. The result shows that CM1 and CM2 have similar milk fat, protein, lactose, SNF, FP and pH to (Potocnik et al 2011; Getaneh et al. 2016; Devendra et al 1996; Walstra et al., 2006). However, TS of CM1 and CM2 is agree with Woldemariam et al. 2017, but lower than result by Devandra et al., 1996 stated that TS from cow was 15.5% and 3.9% for goat milk.

Table 1: Basic milk composition

Samples	Fat (%)	Protein (%)	Lactose (%)	SNF (%)	TS (%)	FP (oC)	pH	Total Soluble Solid (oBrix)	Titratable Acidity (%)
GM	2.2	1.58	2.61	4.53	6.60	-0.27	6.73	8.6	0.17
CM1	3.54	2.90	4.69	8.27	11.80	-0.50	6.5	11.7	0.24
CM2	3.55	3.34	4.16	8.12	11.75	-0.47	6.61	13.25	0.17

Table 2 shows result of bacterial counts in milk products. There was no bacterial colony encountered for both PCA and Coliform bacteria which shows good hygiene of these products both during processing and packaging.

Table 2: Microbial loads in milk products

Samples	General bacteria (PCA)	Coliform
GM	none	none
CM1	none	none
CM2	none	none

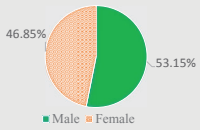

Figure 2: Percentage on Panelists Genders

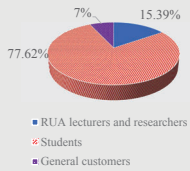

Figure 3: Percentage on Types of Panelists

Table 3 is the result of sensory evaluation on color, aroma, Flavor, Mouthfeel, and General Acceptability. There were 143 panelist, 67 (46.85%) were female as shown in Figure 2.

Types of panelists for the sensory evaluation were RUA lecturers and researcher 15.39%, students 77.62% and general customer 7% as shown in Figure 3. For color, GM was scored 5.92 lower significantly than CM 1 (6.75) and CM2 (6.79) but no significant differences between CM1 and CM2 (Table 3). However, there was no significant differences among samples for aroma (P>0.05) as shown in Table 3 and results ranged from 5.89 to 6.31. For flavor, there were high significant differences among samples (P=0.00), CM2 was scored highest (6.77) then followed by CM1 (6.01) and GM (5.18). For mouth feel, there were significant differences between GM (5.67) and CM2 (6.65) while no significant differences among GM and CM1 (P>0.05) and between CM1 and CM2 (P>0.05). For general acceptability, there were significant differences among milk products (P=0.00) as CM2 was given the highest score of 6.92 followed by CM1 (6.21) and GM (5.61).

Table 3: Sensory evaluation of milk products

Samples Codes	N	Color	Aroma ^{ns}	Flavor	Mouth feel	General acceptability
GM	143	5.92 ±2.01 ^{a}	6.05±2.14	5.18±2.03 ^{a}	5.67±1.89 ^{a}	5.61±1.96 ^{a}
CM1	143	6.75 ±1.72 ^{b}	5.89±1.89	6.01±1.88 ^{b}	6.15±1.88 ^{ab}	6.21±1.81 ^{b}
CM2	143	6.79 ±1.49 ^{b}	6.31±1.75	6.77±1.81 ^{c}	6.65±1.62 ^{b}	6.92±1.69 ^{c}
P-Value		0.00	0.18	0.00	0.00	0.00

Based on 1-9 hedonic point scale (9 extremely like and 1 extremely dislike)
$^{a-c}$ Means within a column with different superscript differ significantly (P<0.05)

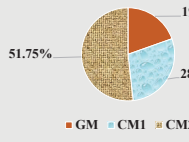

Figure 4: Products ranking as 1st Choice

Figure 4 shows the results of products ranking by panelists as 1st Choice. CM2 received the most rating by 74 panelists (51.75%) for 1st choice, then followed by CM1 as 41 (28.67%) and GM as 28 panelists (19.58%).

Conclusion

For bacterial counts, we found no harmful bacterial encountered in these milk samples which show the safety during processing and packaging of these products. According to the laboratory analysis for basic milk composition, cow milk produced locally had similar milk composition to most literature review while goat milk sample purchased from a company abroad had lowest milk contents. From the sensory evaluation, we can conclude that goat milk had least preference compared to cow milk samples and the cow milk with basic milk composition like cow milk 2 was ranked and scored as best choice among the other samples. However, as we had only one goat milk sample, our conclusion may be a little bit bias for sensory evaluation.

References

Armand, V.C., and O.Maller. 1982. Acceptability of Water, selected beverages and foods as a function of serving temperature. J. Food Sci. 47:1549-1552.

Devendra C, McLeroy GB. (1996) Goat and sheep production in the tropics. 7th edn, Payne, W.J.A and Longman (ed.), London and New York publishers, 1:55.

Dimitrellou D., Solamoura C., Kontogianni A., Katsipi D., Kandylis P., Zakynthinos G., Varzakas T. (2019). Effect of Milk Type on the Microbiological, Physicochemical and Sensory Characteristics of Probiotic Fermented Milk. J. Microorganisms 2019, 7, 274; doi:103390. www.mdpi.com/journal /microorganisms. Retrieved: 02 Dec 2020.

Getaneh G, Mebrat A, Wubie A, Kendie H (2016). Review on Goat Milk Composition and Its Nutritive Value. J Nutr Health Sci 3(4):401. Doi 10.154=744/2393-9060 3.401.

Gomes, J.JL; Duarte, A.M.; Batista A.S.M; De Figueiredo, R.M.F; De Sousa, E.L.; do Egypto, R.D.C.R. Physicochemical and sensory properties of fermented dairy beverages made with goat's milk, cow' milk and a mixture of the two milks. LWT 2013, 54, 18-24.

Haug A, Hostmark AT, Harstad OM (2007) Bovine milk in human nutrition: A review. Lipids in Health and Diseases 6:25.

Hough G., Martinez, E., Barbieri, T. 1992. Sensory thresholds of flavor defects in reconstitute whole milk powder. J. Dairy Sci. 74:2370-2374.

Kapadiya, D. B., Prajapati, D. B., Jain, A. K., Mehta, B. M., Darji, V. B., & Aparnathi, K. D. (2016). Comparison of Surti goat milk with cow and buffalo milk for gross composition, nitrogen distribution, and selected minerals content. Veterinary world, 9(7), 710–716. https://doi.org/10.14202/vetworld.2016.710-716

Ludemann R. L. and Hyde L.W. Rebecca 2015. Standard Operation Policy/Procedure, Standard Bacterial Plate Count. USDA-Center for Veteryary Biologics. BBSOP0019.04

Peacock CP (1996). Improving goat production in the tropics. A manual for development workers Practical Handbook, 2nd edn, Oxfarm, Farm Africa, 308-12.

Potocnik K, Gantner V, Kuterovac K, and A Cividini (2011). Mare's milk: composition and protein fraction in comparison with different milk species. Mljeckastvo 61(2), 107-113(2011).

Walstra, P., J.T.M. Wouters and T.J. Geurts. 2006. Dairy Technology, 2nd Ed. CRC/Taylor & Francis.

Woldemariam HW, Asres AM (2017) Microbial and Physicochemical Quality of Pasteurized Milk. J Food Process Technol 8: 651. Doi:10.4172/2175-7110.1000651.

This research is made possible by the generous support of the American People provided to the Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) of the Royal University of Agriculture through Feed the Future Innovation Lab for Collaborative Research on Sustainable Intensification at Kansas State University funded by the United States Agency for International Development (USAID) under Cooperative Agreement No. AID-OAA-L-14-00006. The contents are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.
Also, the authors would like to thanks to Nagoya University Asian Satellite Campuses Institute, Cambodia campus, Rua office, for supporting with laboratory facility for milk basic composition analysis.