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COMPARATIVE STUDY OF PHYSICOCHEMICAL PROPERTIES OF POWDER MILK FROM COW, SHEEP AND GOAT

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ABSTRACT

The important quality parameters for fresh and powdered milk are physicochemical and microbial qualities, alternative milk powder sources such as sheep and goat milk can be used in place of cow milk due to their availability and high nutritive value. A study on the physicochemical properties of powder milk from cow, sheep and goat was carried out using foam-mat drying method. Fresh milk was collected manually from White Fulani breed cow, sheep and goats used were West Africa Dwarf (WAD) breed at second parity early in the morning. Fresh milk from cow, sheep and goats was collected once per week for period of three months in the morning from Directorate of University Research Farms (DUFARMS), Federal University of Agriculture, Abeokuta, Ogun State which was processed into powdered milk. Powder milk samples were analyzed for chemical and physical properties. Powdered milk result showed that ash content from cow milk (2.755%), sheep (3.17%) and goat (3.145%) and lactose content of cow milk (34.250%), sheep (27.425%) and goat (22.825%) were statistically different ($p<0.05$) while moisture content, fat and protein of powdered milk were not significantly ($p>0.05$) different. In conclusion, milk powder could be sourced from sheep and goat milk as alternative to cow milk due to their availability and high nutritive value.

Key words: physicochemical, powder milk, White Fulani cow, West Africa Dwarf goat, sheep

INTRODUCTION

Milk is one of the most common foods in the human diet and is also a product that is directly available for consumption (Grimaud *et al.,* 2009). Thus, due to a myriad of reasons, many are fed milk formula manufactured from animal milk (Hodgkinson, *et al.,* 2017). Unlike cow milk, which is slight acidic, goat milk is alkaline in nature, which is very useful for people with acidity problems (Tamime *et al*., 2011). This alkalinity is due to the higher protein content and different arrangement of phosphates. The high nutritive value of goat and sheep milk is associated with its chemical composition and the chemical composition of goat milk is similar to cow milk with the main difference in protein and fat structure while sheep milk has higher fat, protein and lactose content (Tamime *et al*., 2011). Dairy powders are a popular commodity due to their long shelf life, ease of storage and versatile nature as milk and dairy products are very rich in several nutrients and enjoined by everybody throughout the world. (Lagrange *et al*., 2015). Nowadays, a great emphasis is given on adding value to powder milk. Therefore, the aim of this study is to determine the physicochemical properties of powder milk from cattle, sheep and goats and to look for alternative powder milk source from sheep and goat milk that can be in place of cow powder milk due to their availability and nutritive value.

MATERIALS AND METHODS

Study area

The milk was collected from Directorate of University Research Farms (DUFARMS) at Federal University of Agriculture Abeokuta, Ogun State, Nigeria. The state covers a land area of about 16,409.26 square kilometer and has humid agro climate characterized by wet season of about eight months. The mean average rainfall distribution per annum is about 1400mm and relative constant temperature Adebowale (2002).

Laboratory analysis of experimental samples

Physicochemical analysis of cow, goat and sheep fresh milk and powder milk production were done at the Animal Product Processing Laboratory, Department of Animal Production and Health. The physicochemical properties of milk powder was carried out at Apex Laboratory Obantoko, Abeokuta. The experiment was carried out between March and July, 2021.

Milk sample and method of milk powder production

A white Fulani cow at second parity, of an average body weight of between 280kg–300kg was milked manually by the Fulani early in the morning. The sheep and goat used were West Africa Dwarf (WAD) breed at second parity with body weight between 15-20kg. The fresh liquid milk of cow, goats and sheep were collected in four series in the morning by 7am.The fresh milk from each of the animals species was collected, kept in sample bottle and carried to laboratory immediately for analysis. Fresh milk (200 ml) was measured into a container and egg albumin 15% of milk volume (200 ml) as foaming agent and 0.5% methyl cellulose as foam stabilizer was added while whipping thoroughly for 15 minutes. The experiment was performed at 65^0 C until the moisture content reached 5%. It was agitated every 2 hours, dried milk that was removed from the vacuum dryer was blended. The blended milk powder was sieved to obtain milk powder with a uniform size. The dried milk powder samples was analyzed for physicochemical. The dried milk yield was calculated as flows:-

$$\text{Dried milk yield (\%)} = \frac{\text{Weight of milk powder}}{\text{Weight of liquid milk}} \times 100$$

Proximate analysis for physicochemical properties of milk

Protein – using titration method, Fat – using separation method by Gerber method, Total solid – using evaporation to dryness, Ash –using muffle furnace, Lactose – using formula method by Lane and Eynon according to AOAC (2003)., pH – using pH meter (Table top Jenway, UK 3015, Dunmow Essex, England). The ash and moisture of milk was determined according to Pearson (1998). The specific gravity, acidity and solubility of milk samples also were determined as described by Pearson (1976). Peroxide value (PV) of milk powder which indicates the extent of overall oxidation was determined according to the AOAC (2003).

Statistical analysis

Data obtained from the study was analyzed using one-way ANOVA as contained in MINITAB (version 17), in statistical package. Significant differences between treatment means was separated using Tukey range test.

RESULT AND DISCUSSION

Table 1 presented the weight of fresh, powdered milk and milk yield. The powdered milk yields were similar across the selected species of animals. This report was in agreement with El- Sara Tag (2005) who reported 13.17% for goat powder milk yield and higher value of 16.44% to cow powder milk yield.

Table 1: **Weight of fresh Milk, Powdered milk and Milk yield**

Parameter	Cow	Sheep	Goat	SEM
Weight of fresh Milk (g)	201.06	199.38	203.36	1.17
Powder milk weight (g)	27.24	26.42	27.39	2.98
Powder milk yield (%)	13.42	13.27	13.41	1.45

SEM: standard error of mean

Chemical properties of milk powder

Chemical properties of milk powder is presented in Table 2. Ash and lactose were statistically different ($p < 0.05$) among the chosen species. The moisture content, fat and protein were not significantly ($p > 0.05$) differ. Sheep and goat's milk had higher ash content than cow's milk. Cow milk had the highest lactose content with goat having the least lactose within the breed. The moisture content reported in this study was at least twice higher than that reported by El- Sara Tag (2005) who reported 5.25% for goat powder milk and 4.78% for cow powder milk. This might be due to the difference in drying method used spraying and foam-mat drying methods. Protein in cow milk powder was similar ($P \geq 0.05$) to that of sheep and goat milk powder which ranged from 38.39% to 39.83%. This data indicated that the protein content of milk powder were higher than that reported by El- Sara Tag (2009) who reported that goat milk powder was 24.84 % and that of cow milk powder was 22.44% while the sheep milk powder was 34.7% as reported by Rachel *et al* (2010). The increase in protein contents of this report might be due to the addition of egg albumin as forming agent which led to the increase in crude protein of the powder milk. The results of fat content ranged from 32.99-34.06% for the three types of powder milk produced and they were similar ($p>0.05$). This result is in agreement with El- Sara Tag (2009) who reported that goat milk powder fat content as 33.28% and that of cow milk powder as 31.57%. The fat contents obtained from this study were slightly higher value than that reported by Walstra *et al*, (2005) who cited 27.25%. Ash content of this study was between 2.76 -3.17%. The goat and sheep milk powder ash contents were similar ($P > 0.05$) and they were significantly higher ($P s< 0.05$) than cow milk powder 2.76%. However, the results of milk powder ash content were lower than Walstra *et al*, (2005) who reported a value of 6.3%. The lactose contents of cow, sheep and goat milk powders were significantly different ($P < 0.05$). The highest value of lactose content 34.25% was found in cow milk, followed by sheep powder milk with 27.43% and the lowest value of 22.83% was found in goat powder milk. The values reported in this study were less than that reported by Eckles and Macy (2004) who gave a value of 36.80 %.

Table 2: Chemical properties of powder milk

Parameters	Cow	Sheep	Goat	SEM
Moisture	15.250	14.553	16.620	0.673
Fat	33.485	34.058	32.988	0.589
Ash	2.755[b]	3.170 [a]	3.145[a]	0.105
Protein	39.223	39.830	38.388	0.542
Lactose	34.250[a]	27.425[b]	22.825[c]	0.701

SEM: standard error of mean

Physical properties of powder milk

The physical properties of milk powder made from different types of animals are shown in the Table 3. The values of pH for cow, sheep and goat milk powder are 6.85%, 6.75% and 6.75% respectively. The pH value of powder cow, sheep and goat milk powder were similar ($P > 0.05$). The milk powder had similar ($P > 0.05$) titratable acidity. This report was similar to El- Sara Tag (2009) who gave value 0.15% for cow and 0.16% for goat milk powder. Cow, sheep and goat milk powder had similar ($P > 0.05$) solubility index. The values of solubility index of milk powder were found to be lower than that reported by El-Sara Tag (2009) who gave value 92.12% for cow and 90.18% for goat milk powder. This might be as a result of presence of egg albumin as foaming agent in foam-mat drying method used. With regard to the data, the peroxide value of the breeds ranged between 3.81 and 4.18% for milk powder and they were similar ($P \geq 0.05$). This was lower than that reported by El- Sara Tag (2009) who gave 4.89% to goat milk and 5.8% to cow dried milk.

Table 3: Physical properties of powder milk

Parameter	Cow	Sheep	Goat	SEM
pH	6.850	6.750	6.750	0.222
Titratable acidity	0.185	0.208	0.200	0.001
Solubility index	60.140	61.000	63.710	1.860
Peroxide value	3.808	4.098	4.175	0.123

SEM: standard error of mean

CONCLUSION AND RECOMMENDATION

Milk from the three species (cow, sheep and goat) produced milk powder with acceptable physicochemical properties necessary for human growth and development. The high ash value of goat and sheep milk is associated with its mineral and vitamins while cow milk has higher lactose content. High protein contents of powder milk of this report is due to the addition of egg albumin as foaming agent which lead to the increase in protein content of the powder milk. Milk powder could be produced from sheep and goat milk as alternative cow milk. Goat fresh milk can be recommended for people with acidity problems due to its alkaline nature

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