Original Research Article

Proximate composition dried liquid fluid with spray drying method with various hydrocolloids

ABSTRACT

Biochemical studies with a view to assess the proximate and essential mineral content of dried liquid fluid with spray drying method with various hydrocolloids were carried out. The values for each of the nutrients were collected in triplicates according to the samples analyzed. The results of mean percentages showed the samples contained moisture (5.8±0.43 to 8.8±0.47), crude protein (9.98±0.43 to 13.08±0.43), Ether Extract (1.29±0.51 to 3.29±0.35), Ash (16.30±0.41 to 22.48±0.32), NDF (28.01±0.42 to 24.20±0.19), and carbohydrates (36.90±0.0.26 to 44.80±0.43). The essential minerals were sodium (2.10±0.05 to 4.95±0.02), potassium (0.46±0.03 to 0.76±0.03), magnesium (0.76±0.06 to 0.96±0.06), calcium (0.33±0.09 to 0.65±0.02) and phosphorous (1.22±0.09 to 1.87±0.08). The results indicated that dried liquid fluid with spray drying method with various hydrocolloids has nutritional qualities that could provide livestock producers with additional nutrients for enhanced animal nutrition. It is therefore recommended for livestock feeding trials in ruminant production.

KEY WORDS: Proximate composition, Liquid fluid, Spray drying, Hydrocolloids

1. INTRODUCTION

The global shortage of animal feed increases the share of livestock feed costs and the income generated by the production of livestock products has been affected (citation is required). In order to compensate for this shortage, the utilization and optimal use? of agricultural waste and agricultural products? as feed in ruminants is inevitable to improve livestock production [1]. Large amounts of rumen content are produced daily as a byproduct in slaughterhouses [2]. These pollutants pollute the environment by releasing toxic gases, including methane, nitrogen dioxide and other gases in the atmosphere [3]. Also, the rumen fluid contains high levels of ammonia and phosphorus [4]. Therefore, rumen fluid is a serious environmental contaminant in most slaughterhouses in developing countries [5]. The contents of the rumen are rich in raw microbial protein and contains forage materials digested in different stages of fermentation, saliva, amino acids, group B vitamins and end products of ruminal fermentation [6] rich in minerals [7], As well as anti-physiological factor [5]. Sun-dried rumen digesta has been reported to contain 11.18% crude protein, 22.99 crude fiber, 1.22% ether extract, 21.54% ash, 0.20% calcium and 0.45% phosphorous [8]. Sakaba et al. [9]. also reported the composition of 5.83% moisture, 15.52% crude protein, 5.17% lipids, 48.17% fiber, 11.00% ash, 19.98% soluble carbohydrate, 19.98% Sodium, 4.37% Potassium, 0.42% magnasium, 0.45% calcium and 4.37 % phosphprous from sun-dried rumen digesta. The benefits of recycling these first waste reduces environmental pollution, secondly, as it is a source of feed for ruminants [3]. With proper processing, the rumen content can provide a large supply of nutrients when it enters the ration [10]. And the protein needs of high-producing animals [11]. Drying can be used as a solvent reduction, which is usually water, to produce a stable and saveable product [12]. Spray drying is one of the encapsulation methods used to dry the heat-sensitive materials and a simple, quick, and economical technique for obtaining a powder from a solution or a liquid suspenson (such as an enzyme suspension [13]. Some binding agents, such as some disaccharides, are added to the protein and improve sustainability during the build and save process. Many studies have shown the protective effects of connective materials for denaturation [14]. Therefore, some carbohydrates (such as starch, maltodextrin and dextrose), gums (such as Arabic gum, acacia gum, sodium alginate and carrageenans), proteins (such as milk or whey protein, gelatin) and chitosan are used in spray drying methods [15]. So far, no research has been done on the approximate compounds of dried ruminal fluid by spray drying method with different hydrocolloids. This study was conducted to determine the composition of t this substances.

2. MATERIALS AND METHODS

2.1 Sample preparation and spray drying

The rumen contents were taken from the slaughterhouse and was transferred to a lab inside a pre-warmed containers. Then, the ruminal fluid containing digestive material was mixed with a blender for 2 minutes while injected with carbon dioxide gas. In order to separate rumen fluid from rumen solid materials filtration through four-layers cheesecloth was used. Then, The collected rumen fluid were spray dried by using different hydrocolloids including sodium alginate (Sigma-Aldrich, CAS Number, 9005-38-3, chemical Book), guar gum (Sigma-Aldrich, CAS Number, 9003-30-0), chitosan (Sigma-Aldrich, CAS Number, 9012-76-4, Tokyo chemical Industry Co. Ltd), and maltodextrin (Sigma-Aldrich, CAS Number 9050-36-6, SCBT-Santa Cruz Biotechnology) in two ratios 0.5 and 1% (w/v).The experimental groups were: 1) spray dried rumen fluid with 0.5% maltodextrin (RM0.5), 2) spray dried rumen fluid with 1% maltodextrin (RM1), 3) spray dried rumen fluid with 0.5% chitosan (RC0.5), 4) spray dried rumen fluid with 1% chitosan (RC1), 5) spray dried rumen fluid with 0.5% guar gum (RG0.5), 6) spray dried rumen fluid with 1% guar gum (RG1), 7) spray dried rumen fluid with 0.5% alginate (RA0.5), 8) spray dried rumen fluid with 1% alginate (RA1), 9) spray dried rumen fluid with no hydrocolloid (RN). A laboratory scale spray dryer (Armfield Mini Spray Dryer, England) with two-fluid nozzles (inner diameter: 0.5 mm) was used for spray drying. The system was operated in a co-current manner with an inlet and outlet air temperature of 120 C and 50 C, respectively. Feed rate change in 240e640 mL/h was necessary to achieve a constant outlet temperature. A spray flow rate of 500 mL/h was used and the aspiration rate was 70%. The powdered samples were stored in two layers polyester bags and kept in the refrigerator (5 C) until analysis.

2.2 Determination of organic nutrients

The proximate composition of dried liquid fluid with spray drying method with various hydrocolloids was analyzed as described by AOAC [16]. Four samples were analyzed for each nutrient. In order to determine the moisture content of the samples, it was oven dried using hot air drying oven (Galenkamp England) at 105°c to obtain a constant weight. The rumen content was burnt into ash in order to determine the ash and fiber using Lenton Furnace, England. The crude protein was determined through micro kjeldahl method using Macro Kjeldhal Digestion and Distillation Apparatus (Gerhardt, Germany) and by multiplying the nitrogen content with a factor 6.25. Ether extract was also determined using Soxhlet extraction method while Nitrogen Free Extract (NFE) by subtracting the sum of % ash, % crude fiber, % crude fat and % crude protein from 100. That is: NFE = 100 − (%ash + %NDF + %Ether Extract + % crude protein).

2.3 Determination of minerals

The mineral contents of the samples were analyzed as described by AOAC [16]. Potassium and sodium were determined by Photometric method using FP 640, Jeumeay while phosphorous was determined through Vonado molybdate Yellow method using spectrometer Jenway 1315 UK (UV-visible). Calcium and magnesium were determined using Atomic Absorption Spectrometer (Buck 210, AAS).

2.4 Data collection and statistical analysis

The nutrients analyzed in the laboratory were divided into organic and inorganic and expressed as percentages of mean, the results were expressed as percentages of mean and standard error of mean as described by Aliyu et al. [17].

Table 1. Approximate analysis of ruminal liquid dried with the spray drying method to various hydrocolloids

Item	Moistre (%)	CP (%)	EE(%)	Ash(%)	NDF(%)	NFE(%)
RM0.5	6.6±0.30	12.55±0.29	2.96±0.21	21.00±0.35	24.20±0.19	39.29±0.25
RM1	6.2±0.41	12.27±0.33	2.19±0.33	22.38±0.51	24.65±0.35	38.51±0.36
RC0.5	6.3±0.33	13.08±0.44	2.80±0.51	17.00±0.23	27.60±0.38	39.52±0.41
RC1	6.9±0.43	11.85±0.36	3.29±0.35	16.95±0.54	28.01±0.42	36.90±0.36
RG0.5	6.8±0.36	10.5±0.54	2.39±0.41	22.48±0.32	26.21±0.24	38.42±0.52
RG1	5.8±0.43	9.98±0.43	2.64±0.52	20.00±0.65	27.32±0.22	40.06±0.38
RA0.5	6.8±0.53	12.92±0.54	2.86±0.36	16.70±0.21	24.62±0.25	42.90±0.39
RA1	8.8±0.47	12.30±0.34	1.92±0.51	16.30±0.41	25.30±0.64	44.18±0.43
RN	6.2±0.32	10.6±0.34	2.85±0.41	20.15±0.45	25.23±0.35	44.17±0.56

Values presented in means and standard errore of means (Means±SE)

Table 2. Inorganic cpmposition of ruminal liquid dried with the spray drying method to various hydrocolloids

Item	Sodium (%)	Potassium(%)	Calcium(%)	Magnesium(%)	Phosphorous (%)
RM0.5	3.02±0.03	0.75±0.03	0.65±0.02	0.96±0.06	1.5±0.06
RM1	2.95±0.02	0.61±0.05	0.58±0.06	0.98±0.09	1.65±0.07
RC0.5	2.52±0.04	0.57±0.04	0.53±0.08	0.95±0.08	1.35±0.08
RC1	2.65±0.02	0.68±0.02	0.56±0.06	0.85±0.05	1.22±0.09
RG0.5	2.20±0.6	0.46±0.03	0.45±0.08	0.76±0.06	1.36±0.05
RG1	2.10±0.05	0.48±0.06	0.57±0.09	0.89±0.07	1.65±0.09
RA0.5	4.30±0.06	0.54±0.05	0.33±0.06	0.91±0.08	1.87±0.05
RA1	4.65±0.02	0.65±0.03	0.36±0.09	0.85±0.05	1.85±0.08
RN	2.45±0.05	0.67±0.06	0.55±0.05	0.96±0.08	1.35±0.05

Values presented in means and standard errore of means (Means±SE)

3. RESULTS AND DISCUSSION

The results of the organic compounds of ruminal liquid dried with the spray drying method to various hydrocolloids are shown in Table 1. The amount of moisture has a range of 5.8±0.43 to 8.8±0.47 and is the highest in RA1 and the lowest in RG1. The values for moisture are lower than 14.64% and 17.48% reported by Gebrehawariat et al. [8] and Agbabiaka, Madubuike and Amadi [18]. Variation in the moisture content of the material for this study could be attributed to the processing method of the sample. The amount of moisture for this study has however indicated that the this materials can be kept for a long period of time without deterioration when properly dried. The crude protein content of this material ranged from 9.98±0.43 to 13.08±0.44 and the highest was RC0.5, and the lowest was RG1. These values were lower than the 18.58 percent reported by Agbabiaka, Anukam and Nwachukwu [19]. And in the study of Gebrehawariat et al. [8]. 11.80 and in Sakaba et al. [20]. study it was reported at 15.35%.Variation in the values of crude protein could be attributed to the diversity and the quality of the forage material consumed by the animal and the nutrient status of the soil to which the plants derived their nutrition. It could also be due to the population and activities of micro-organism in the rumen, pre-slaughtered feeding regimen and chemical composition as well as variation in the species of the forages consumed by the animal before slaughter [21,22]. This level of protein suggests supplementation of these substances in the ruminant diet. The amount of Ether Extract has a range of 1.29±0.51 to 3.29±0.35 and the highest was RC1, and the lowest was RA1. These values were higher than 1.22 percent and 1.69 percent reported by Gebrehawariat et al. [8]. and Agbabiaka, Madubuike and Amadi [18]. Variation in the lipid content could be attributed to the diversity and the stage of maturity of the forage. And the amount of ash in the study by Gebrehawariat et al. [8]. was 21.47%. The amount of 16.30±0.41% for RA1 and 22.48±0.32% for RG0.5 for ash in this study was less than the 48.73% reported by Sakaba et al. [9]. And the amount of ash in the study by Gebrehawariat et al. [8]. was 21.47%. The NDF content has a range of 24.20±0.19 to 28.01±0.42. And its highest value in RC1 and its lowest value in RM0.5. These values were greater than 11.00%, 18.44% and 22.99 reported by Sakaba et al. [9]. Sakaba et al. [20]. and Gebrehawariat et al. [8]. And of the 34.91 percent reported by Agbabiaka, Madubuike and Amadi [18]. difference in the values for ash and NDF could be explained by the maturity stage of the forage material consumed and the feeding habit of animals and the nature of tropical forage materials which increases in fiber as the mature Agbabiaka, Madubuike and Amadi [18]. Chitosan also increases fiber in this study. The amount of carbohydrates (36.90±0.0.26 to 44.18±0.56) in this study was more than 19.98 reported by Sakaba et al. [9]. And with amount 40.8 of and 38.13 reported by Dairo et al. [21]. and Agbabiaka Madubuike and Amadi [18]. almost equal. This is attributed to the sparing effect of carbohydrate. The values for these chemical have indicated the ability of the dried rumen fluid with spray drying method with various hydrocolloid provide the nutrient required for normal daily activities of livestock.

The approximate analysis of the inorganic compounds ruminal liquid dried with the spray drying method to various hydrocolloids has been shown in Table 2. The amount of sodium has a range of 2.10±0.05 to 4.95±0.02 in this study, with the highest value of RA1 being the lowest in RG1. The RA1 has sodium. That this amount of sodium was less than 19.98 percent reported by Sankaba et al. [9]. In the Sakaba et al. [9]. study was 2.46 percent. The amount of potassium in this study ranged from 0.46±0.03 to 0.76±0.03. The amount of potassium in the Sakaba et al. [9]. study was 0.64%. The amount of calcium had a range of 0.33±0.09 to 0.65±0.02 in this study. In this study, the amount of magnesium was 0.76±0.06 to 0.96±0.06 and the phosphorus content was 1.22±0.09 to 1.87±0.08 percent. This study showed that the ruminal fluid dried with spray drying method with different hydrocolloids had a small amount of minerals.

4. CONCLUSION AND RECOMMENDATIONS

The values for organic and inorganic compositions obtained from ruminal fluid dried with spray drying method with different hydrocolloid….. indicated the ability of this Materials to provide the nutrients particularly protein required by animals for normal physiological activities. It also has minerals. And it can be concluded that this environment is alive and can be used to feed animals as an additive.

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