



Effect of the inclusion of banana silage in the diet of goats on physicochemical and sensory characteristics of cheeses at different ripening times

Arturo A. Rincón^a, José M. García-Fraga^a, Sergio Álvarez^b, Verónica Pino^a,
María R. Fresno^b, Juan H. Ayala^a, Ana M. Afonso^{a,*}

^a Departamento de Química, Unidad Departamental de Química Analítica, Universidad de La Laguna (ULL), La Laguna, Tenerife, 38206, Spain

^b Animal Production and Forage Research Unit, Canary Agronomic Research Institute (ICIA), La Laguna, Tenerife, 38200, Spain

ARTICLE INFO

Article history:

Received 7 November 2016

Received in revised form

22 December 2016

Accepted 25 December 2016

Available online 29 January 2017

Keywords:

Goat

Raw milk

Diet

Banana silage

Cheese

Sensory analysis

ABSTRACT

The utilization of agro-industrial byproducts into the diets of dairy goats is an alternative feeding covered in this study. The differences between the physicochemical and sensory characteristics were obtained for Canary Islands cheeses made with raw milk of goats fed with a control diet (CD) or with a banana silage-based diet (BD), and ripened at different times. Banana silage-based diets were: BD1 with ~10% of banana packaging residues silage; and BD2 with ~20%. The incorporation of BD to the diets leads to cheeses without significant modifications of their physicochemical properties while keeping flavour and odour attributes typical of Canary cheeses, and without flavour defects. The inclusion of banana silage in the diets clearly implies the detection of citric and fermented fruit odours, which are not present in CD cheeses. Cluster analysis, principal component analysis, and lineal discriminant analysis, were used to evaluate differences on the studied parameters of the cheeses.

© 2017 Elsevier B.V. All rights reserved.

1. Introduction

Several factors exert an influence in the sensory characteristics of cheeses. Among them, the microbiological and the chemical composition of milk can be highlighted, particularly for cheeses elaborated with raw milk. In this sense, there is a clear influence of the genetic, physiology and feeding of the ruminants on the resulting cheeses (Coppa et al., 2011).

The influence of feeding regimen of the ruminants on cheese sensory characteristics has been a research topic in a great number of studies. The effects of forage types such as: hay, grass silage, maize silage, pasture, and so on, are well known (Martin et al., 2005; Coppa et al., 2011; Valdivielso et al., 2016). These studies are particularly important when a cheese has been designated as Protected Designation of Origin (PDO), because such feeding regimen consti-

tutes one of the bases of the PDO relationship with the land where those cheeses are produced.

It is quite common the utilization of agro-industrial by-products and their quality silages in animal nutrition (Bampidis and Robinson, 2006). The utilization of silage by-products is a simple and a low-cost approach. It allows the preservation of feeds that are seasonably abundant, for a later feeding during periods of feed shortage. An interesting option to ensure high quality of any ensiled feed resource and good conservation is the incorporation of additives such as molasses. The purpose of using agro-industrial by-products and their quality silages is not only to decrease feeding costs by reducing dependency on highly expensive ingredients such as grains and forages (which in turn is also adequate for areas where the natural forage is insufficient) (Álvarez et al., 2015) but also to meet environmental requirements by recycling waste materials (which in turn would also decrease waste management costs) (Bampidis and Robinson, 2006; Jaramillo et al., 2006; Salvador et al., 2014). In any case, the selection of adequate agro-industrial by-products supplementation should be based on economical (low price), nutritional (rich in nutrients), and toxicological (free of toxins or other substances) considerations.

* Corresponding author.

E-mail addresses: aarincon@ull.edu.es

(A.A. Rincón), jfraga@ull.edu.es (J.M. García-Fraga), sergioalvarezrios.sa@gmail.com

(S. Álvarez), veropino@ull.edu.es (V. Pino), mfresno@icia.es (M.R. Fresno),

jayala@ull.edu.es (J.H. Ayala), aafonso@ull.edu.es (A.M. Afonso).

Large amounts of agro-industrial by-products (citrus pulp, grape marc, tomato pulp, olive cake, wheat bran, date palm, etc.) have been successfully ensiled in different modes worldwide, used as sole ingredients or in different mixtures (Vasta et al., 2008).

Banana rejected fruits are very interesting by-products for ruminants because they have a net energy value close to that of barley. They are usually fed fresh or ensiled. Good silage can be made from equal parts of chopped green bananas and grass or from chopped green bananas mixed with molasses; being in this way a suitable feed for goats, which can consume up to 5 kg of fresh bananas per day (Pieltain et al., 1998).

The Canary Islands produce over 390,000 tons of bananas per year, making the archipelago the most important producer of bananas in Europe. Clearly, the most common agro-industrial by-products available in large quantities in the Canary Islands are banana packaging wastes. In fact, banana wastes consist of (i) the banana crop residues (stem and leaves) and (ii) the wastes coming from the classification and packaging process (bunch and bananas), and are often used fresh. Ten per cent of the weight of banana fruits (40–50 kg) can be considered waste product in the packaging, conditioning and classification process, before banana commercialization. Of this 4–5 kg, about 3 kg would correspond to the bunch and about 2 kg to the banana fruit waste. The annual production of banana packaging by-products in the Canary Islands is estimated to be around 39 million kg of fresh matter.

The evaluation of the fermentative and nutritive characteristics of the banana silage, and the effects of incorporating banana silage into goat diets on the feeding behaviour, milk yield and physical quality of their milk, have been studied (Álvarez et al., 2015).

However, its effects on the physicochemical and sensory characteristics of the obtained dairy products are also important and, up-to-date, they have not been studied.

The flavour compound profile is an important aspect for cheese marketing, since it is a real fingerprint of a cheese and directly responsible for acceptance of consumers (Fresno and Álvarez, 2012; Niimi et al., 2016). The proteolysis and the lipolysis are among the most important reactions taking place during cheese ripening, being responsible for the texture changes and for the appearance of the characteristic cheese aroma. Thus, it is obvious that the flavour of a cheese not only depends on the diet type of the ruminants but also on the kind of cheese ripening, among other factors.

The aim of this study was to evaluate and compare the physicochemical and sensory properties of cheeses from the Canary Islands prepared with raw milk of goats fed on (i) a conventional diet and (ii) on two diets supplemented with banana silage. These studies use multivariate techniques. In all cases, the physicochemical and sensory properties of cheeses were evaluated at three different ripening times: 7, 45 and 90 days, to evaluate also the influence of the ripening.

2. Material and methods

2.1. Canary goats and the diets utilized

The studies were carried out at the Animal Production Unit of the Canary Agronomic Research Institute (ICIA, Tenerife, Canary Islands, Spain). Thirty multiparous Canary goats (Majorera, Palmera and Tinerfeña breeds) were divided into 3 equal groups based on their lactation number, milk production, and type of caprine breed. Specifically, each group had 4 Majorera goats, 3 Tenerife goats, and 3 Palmero goats. All three breeds are typical from the Canary Islands, and despite they are normally individually exploited, there are mixed flocks. Regarding lactation, each group had 2 goats in their first lactation, 7 goats in their 2nd to 5th lactation, and 1 goat with more than 5 lactations. These goats were bred in the

Table 1
Ingredients composition (g day⁻¹) of the diets provided to the goats.

Parameter	Diet CD	Diet BD1	Diet BD2
Cereal and legume mixture	1153	922	691
Corn grain	578	516	430
Lucerne pellets	494	494	494
<i>Festuca</i> hay	445	445	445
Banana packing residue silage	0	270	540

Table 2
Physicochemical characteristics and net energy content of the diets provided to the goats.

Parameter	Diet CD	Diet BD1	Diet BD2
Dry matter (DM) (%)	86.98	79.70	72.09
Organic matter (% of DM)	92.70	91.90	91.40
Crude protein (% of DM)	11.11	10.60	10.10
Neutral detergent fibre (% of DM)	26.56	26.16	25.28
Acid detergent fibre (% of DM)	17.67	17.60	17.14
Acid detergent lignin (% of DM)	3.64	3.63	3.51
Net energy (MJ kg ⁻¹ of DM)	6.00	6.12	6.18

traditional season (December), and the trial began in March (mid-lactation period).

Three diets were used, one for each group of goats: a control diet (CD), with no addition of any agro-industrial by-product; and two diets incorporating different amounts of banana packing residues silage. These banana silage-based diets were, specifically: BD1, with ~10% of banana packaging residues silage; and BD2, with ~20% of banana packaging residues silage. The rations given to goats were totally consumed, without leftovers. The adaptation period of animals to the experimental diets was 20 days. It is important to mention that the amount of concentrates and forages given in the diets was carefully estimated to cover the same maintenance and milk production requirements as those recommended by the *Institut National de la Recherche Agronomique* (INRA). The quantities of each provided diet were calculated and controlled during the entire study, to ensure identical supplies of energy and proteins. The detailed composition, physicochemical and net energy content, of the three diets (CD, BD1 and BD2) is listed in [Tables 1 and 2](#).

Banana packaging residues silage is a fermented feed made up by agro-industrial by-products. It is composed by 77% of banana fruit and bunch waste, 15% of cane molasses, and 8% of dry beet pulp. The chemical composition of the banana packaging residues silage was: 26.6% of dry matter (DM), 85.5% of organic matter (% of DM), 6.2% of crude protein (% of DM), 16.3% of neutral detergent fibre (% of DM), 11.8% of acid detergent fibre, and 12.5 MJ kg⁻¹ (of DM) of net energy.

2.2. Milk collection and cheese manufacture

The milk produced by each of the 3 experimental groups was taken in 4 consecutive days to make cheeses. Overall, 12 cheese-making processes were completed in the traditional manner (Sánchez-Macías et al., 2010) by the same cheesemaker, in the pilot plant located at the ICIA. Every day, 3 vats were filled with 20 kg of milk, one with CD milk, another with BD1 milk, and the last one with BD2 milk. Three cheeses were obtained from each vat. Overall, 36 cheeses were obtained (9 every day).

The cheeses were made the same day that it was milked. Milk was not pasteurized. After heating to 30 ± 1 °C, ChoozitTM starter (Danisco, France), previously diluted, was added with a dose of 36 mg/L of milk, and left for 45 min. Then, a CarlinaTM animal rennet (95% chymosin and 5% pepsin) (Danisco, France), commonly used by farmers, was added following the instructions of the manufacturer, to obtain clotting within 30–35 min. After coagulation, all curds were cut to obtain grains with the size of millet. All cheeses

Download English Version:

<https://daneshyari.com/en/article/5544270>

Download Persian Version:

<https://daneshyari.com/article/5544270>

[Daneshyari.com](https://daneshyari.com)