MILK BIOCHEMICAL COMPOSITION AND HISTOLOGICAL STRUCTURE OF THE MAMMARY GLAND IN RELATION TO THE HORMONAL PROFILE IN RABBIT DOES

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Abstract

The objective of this work is to study the variation of physicochemical parameters of milk produced by rabbits does during lactation period, histological changes affecting the mammary gland and hormone profiles (prolactin, progesterone and estrogen). Thirty does of synthetic strain (SS) were inseminated (AI) and followed for three reproductive cycles during the summer season. The physicochemical parameters of milk were determined. A histological study was performed on the mammary glands taken from 6 rabbits does. The assay of reproductive hormones was performed to complete this study.

Synthetic strain does produce on average 2693,04g of milk over the three weeks of lactation, which is 128,24g of milk/day. The analysis showed a variation of chemical and biochemical parameters of milk during the three weeks of lactation. Primiparous does produce richer milk in fat and protein, which explain the high rate of growth and the lowest mortality of young rabbits, recorded during this phase in this strain. Histological changes in the mammary gland were observed with a specific hormonal profile for this period. The peak of prolactin is observed throughout the lactating period allowing the maintenance of this production.

Key words: *milk, mammary gland, prolactin, protein content, fat*

INTRODUCTION

Feeding rabbits depend exclusively on the so consumed milk produced by the mother. It is the only food for rabbits during the first seven days of life. In sufficient quantity, it allows harmonious growth of young rabbits during lactation (Fortun Lamothe & Gidenne, 2003). In Algeria, although local population especially the white population (PB) of rabbits exist and are well adapted to climatic conditions, their prolificacy and weight are too low (Zerrouki *and al.*, 2007 and 2014).

The introduction of a "synthetic" strain (SS) and its dissemination through the farms has improved the adult weight and prolificacy weaning rabbits (seems like a good alternative) (Gacem & Bolet, 2005; Gacem *and al.*, 2008). Comparison of the reproductive performance of rabbits belonging to both high genetic types: white population (PB) and strain (SS), in Tigzirt area showed superiority of the latter for the characters' prolificacy at birth, weight of does and of litters born and weaned (Lebas *and al.*, 2010; Zerrouki *and al.*, 2014). The increase of weaned number may be related firstly to the weight of alive born (average 55-56g) and milk produced by does during lactation phase (Chibah-Aït Bouziad *and al.*, 2014). Few studies estimated milk production of synthetic strain does (Zerrouki *and al.*, 2012; Chibah-Aït Bouziad *and al.*, 2015). A study of milk quality, specially the milk protein fraction of this genetic type has firstly identify the key rabbit's milk protein and showed individual variability within and between genetic groups (Amroun *and al.*, 2015).

The aim of our study is to define milk composition of synthetic strain does during the three weeks of lactation, associated with blood prolactin levels and changes affecting the mammary gland during this state.

MATERIAL AND METHODS

The experiment was conducted over a period of about four months (from June 2014 to September 2014) in a rabbitry located in the region of Tigzirt (Tizi Ouzou, Northern Algeria) which is characterized by Mediterranean climate (average temperature of 30°C during the day and 23°C at night in summer).

Thirty females of synthetic strain (SS) were mated with males of the same genetic types and followed during three lactation cycle (21 days). At parturition, the litters were counted, weighed and equated to 8 young rabbits per female. Milk samples were taken manually (without hormonal stimulation) twice a week during the three weeks of lactation. The milk collected during the summer was supplemented with Thiomersal (5%) before being frozen at -20°C. The analysis was performed on the milk samples taken from does feeding and watered *ad libitum*.

The physical and biochemical parameters of milk were evaluated by current technical standards (AFNOR, 1986). Stringent hygiene conditions have been met during milking. Weekly collections were conducted in summer (June-September 2015). Mammary glands of 6 does were used for histological study: Formalin fixation, dehydration with ethanol and staining with hematoxylin saffron. Hormone levels were measured by the nuclear method.

All results were presented as mean values followed by the standard error of the mean (X ± SEM). The statistical significance of differences between means compared is evaluated by the "t" test of Student Fisher using Statistica software.

RESULTS AND DISCUSSION

1. Physicochemical and biochemical parameters of milk

Physicochemical characteristic of milk

The results of the physicochemical analysis obtained on rabbit's milk samples are presented in Figure 1. During the three weeks of lactation, the pH did not present significant differences (P> 0.05). pH stability achieved in our milk samples may be explained by our methods of conservation from any degradation (proteolysis and lipolysis activity). In the other hand, we noted that the milk density of rabbit does remains stable and did not change over the three weeks of lactation (figure 1).

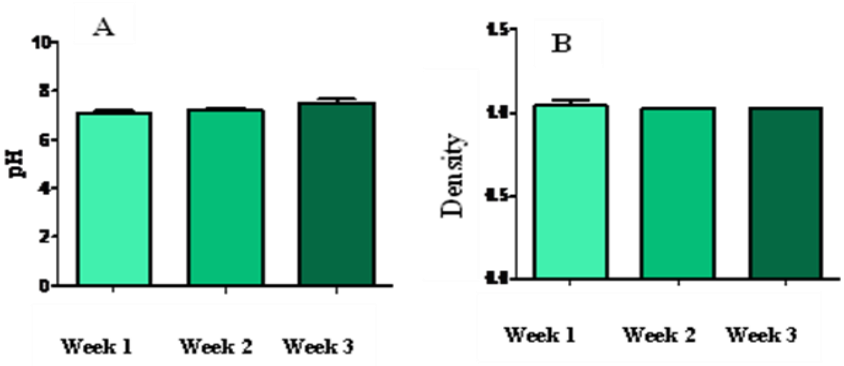


Figure 1. Value of pH (A) and density (B) of the milk samples collected during the three weeks of lactation.

Milk composition

During suckling period, milk collected on synthetic female's showed variation of the measured parameters namely dry matter (DM), protein and fat (MG) per week of suckling. Dry matter (DM), protein and fat contents were higher during the first week of lactation (DM: 310 ± 5.31 g / l; Proteins: 117.95 ± 3.05 g / l and fat: 192 ± 2.8 g / l), and decreased very significantly (P <0.01) at second week (DM: 263 ± 1.36 g / l; protein: 107.42 ± 3.9 g / l and fat: 155 ± 2.5 g / l). During the third week, these contents increased very significantly (P <0.01). Milk contents of dry matter (DM) and fat contents (MG) collected during the first and the third week of lactation are not different (Figure 2).

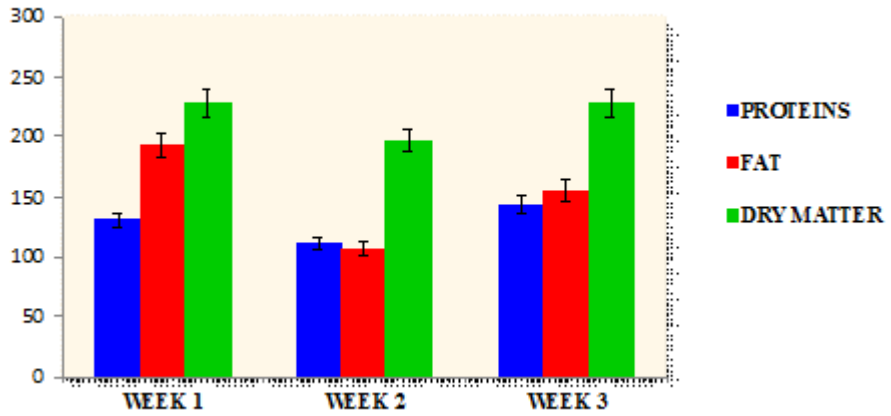


Figure 2. Evolution of the milk composition of synthetic rabbit does during the three weeks of suckling

Milk contents variation, including the fall of the protein and fat levels during the second week of lactation was also observed by Boucher *and al.* (2007) on milk samples collected from albinos rabbits of the strain NZW 052. Some studies noted a little variation in milk composition between breeds like the New Zealanders White, or commercial strains (Maertens et al., 2006).

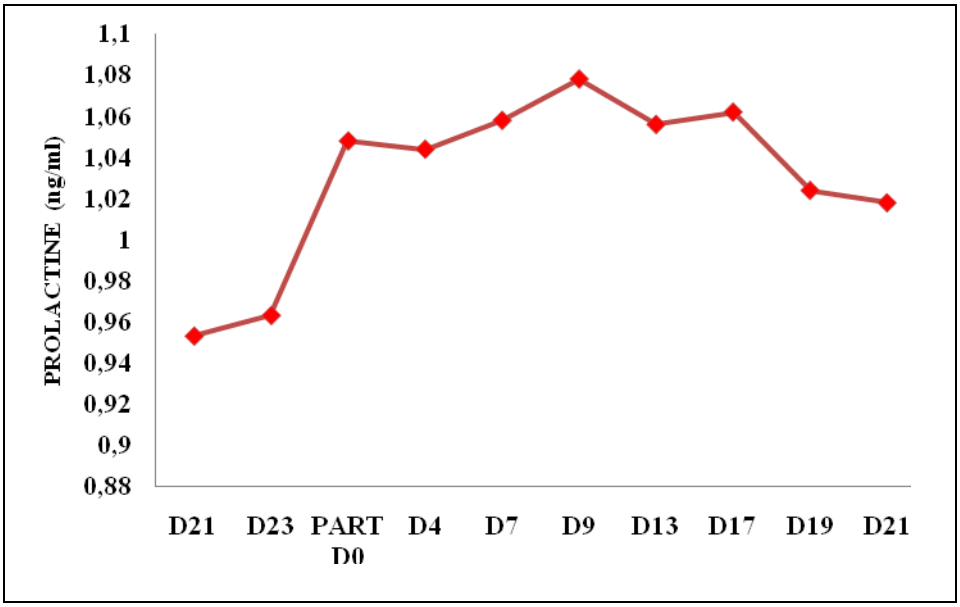
Along the same, Fajemilehin and al. (2013) reported variation of milk composition according to week of lactation (Protein contents in week 1: 116 g / l, week 2: 111g / l, week 3: 108g / l; Fat contents in week 1: 152 g / l, week 2: 121g / l, week 3: 117g / l). The fall in biochemical components can be observed in the first week and continues through the third week of lactation.

Like the data obtained in our experiment, the fat content observed greatly exceeds the protein content all along lactation. The fall of the biochemical components can be observed in the first week and continues until the third week of lactation. In our experiment, the fat content obtained is far beyond the protein level throughout lactation.

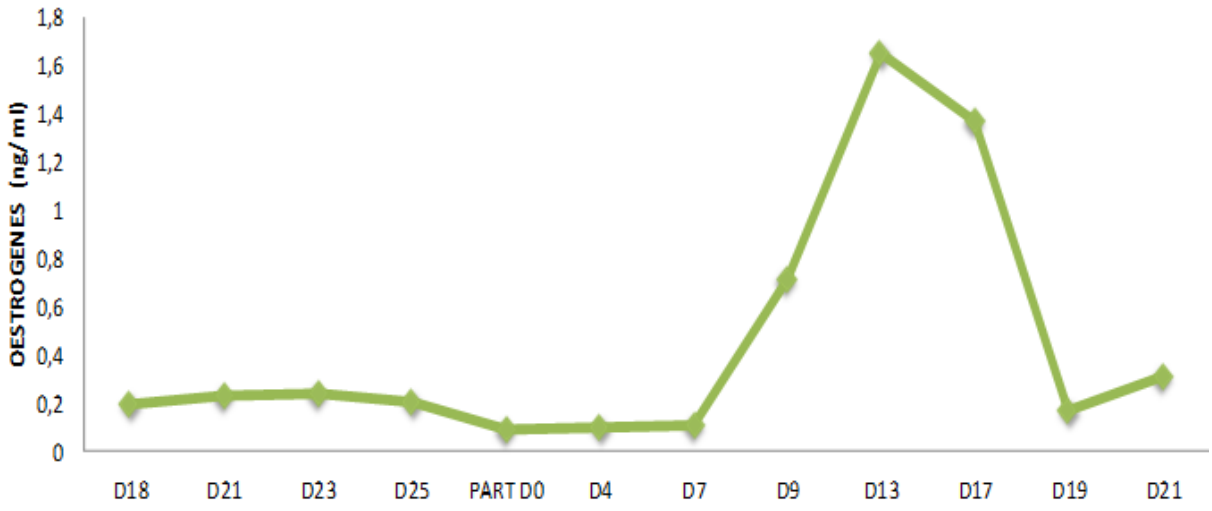
Compared with goat milk or sheep, rabbit milk is richer in nutrients, except for the lactose content (Lebas, 2002).

2. Hormonal profile of rabbits during lactation

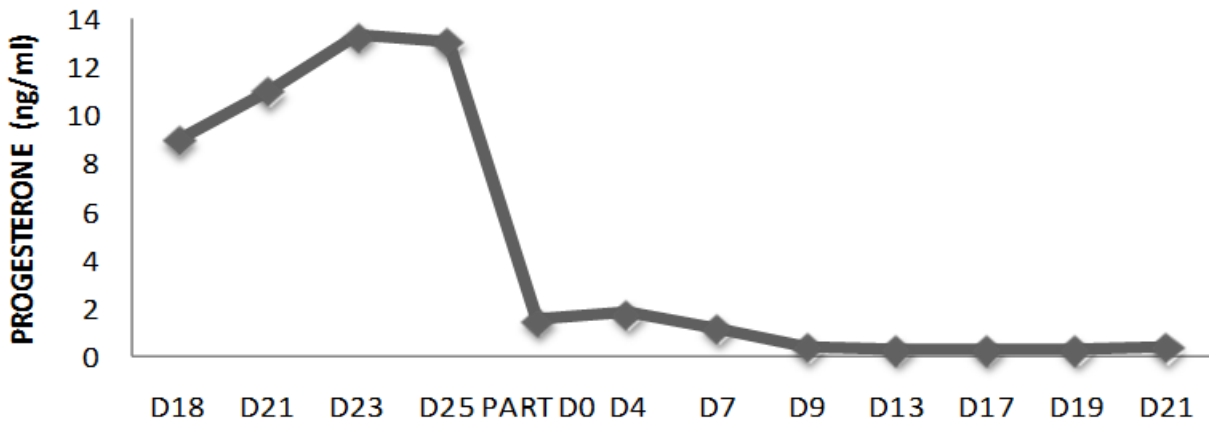
Figure 3 shows the results of hormonal analysis carried on rabbit does blood at mid-gestation and during suckling period. The assayed hormones are progesterone, estradiol and prolactin.



A.



B.



C.

Figure 3. Results of the assay of the PRL (A), E2 (B) and PRG (C) in the rabbit doe from mid-gestation to lactation day 21st.

In gestation period, estradiol plays a crucial role in the mammogenesis. First, fostering the development of the mammary ducts, and on the other, it increases the number of progesterone receptors and epithelial cells sensitize this last.

At the same time there is a high rate of progesterone. The latter allows the development of structure relative to lobuloalveolar mammogenesis and inhibits the lactogenic effect of prolactin whose role is reduced to the stimulation of mammary growth and lactation initiates (lactogenesis I).

At parturition, progesterone levels fall sharply, causing the lifting of the lock on the lactogenic action of prolactin secretion synthesis of the different elements of the milk becomes abundant. During lactation, prolactin levels remained stable, which allows the maintenance of lactation. Estradiol promotes the formation of prolactin receptors, which could explain its peak on day 13.

3. Histological study of the mammary gland

Some observations of blades Nanozoomer and lower magnification after staining with hematoxylin-eosin (HE) reveal the presence of three tissue types: mammary glandular tissue (TG), connective tissue (CT) and adipose tissue (AT) (Figure 4). The mammary parenchyma is recognizable by the presence of mammary lobes (L) appearing well individualized and separated by wide strips of connective tissue.

Figure 4A shows predominance from adipose tissue compared to glandular tissue in the empty rabbit, it undeveloped gets organized in the form of lobes having, at higher magnification, multiple small lobules (Figure 4B), and comprising cellular structures reduced the lights.

In lactating doe, the activity of the mammary gland is observed at low magnification by the importance of the epithelial component, whose alveolar structures are expanded (Figure 4B). In this phase of lactation, hypertrophied epithelial component outweighs in volume the conjunctiva component.

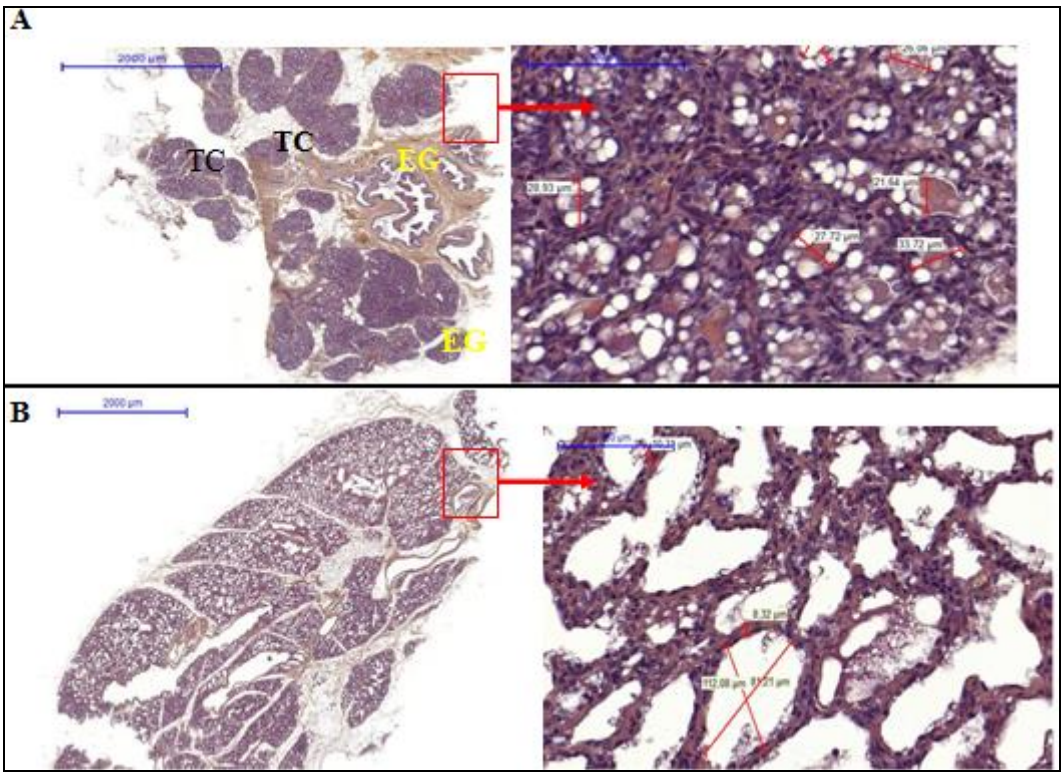


Figure 4. Histological sections of the mammary glands of does at different physiological stages, stained with hematoxylin and saffron observed at different magnifications.
A: pregnant doe, B: lactating doe, EG: Glandular epithelium, L: light acini, TC: Connective Tissue

CONCLUSION

The preliminary results of the chemical and biochemical analysis of synthetic strain rabbit's milk during the three weeks of lactation have led to the following conclusions:

- Milk from synthetic strain of rabbits is rich in fat and protein contents. High levels are recorded during the first and the third weeks of lactation.
- This wealth, in relation to the high milk quantities produced, quoted in our earlier works in 2015, can explain the best rate of growth of this strain and the low mortality recorded during the suckling phase.
- This study also confirmed the change in the composition, depending on the genetic type reported by other authors.
- Histological study revealed morphological changes in the mammary gland during physiological stage, especially at the dominance of the mammary epithelium on the surface of connective tissue.

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