# The Effect of Incorporating Date Waste and *Saccharomyces Cerevisiae* into the Diet of Ouled Djellel Ewes during Early Lactation and Late Lactation

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## ABSTRACT

**Background:** This study aims to determine the effects of supplementary diets with date waste and Saccharomyces cerevisiae on biochemical parameters in Ouled Djellel ewes at early and late lactation.

**Methods:** Thirty pregnant ewes, were divided into 5 groups. All ewes received wheat straw (1 kg),in addition to wheat straw, the control group (33CON) received 500 g of concentrate. The other groups (8.33REB, 25REB, 16REB, 16REBsc) were fed with a mixture of date waste and concentrate in different proportions and *Saccharomyces cerevisiae* at a rate of 2 gr/ewe for the 5th group. Blood samples were collected at the beginning and at the end of lactation to determine biochemical profile by spectrophotometry. Feed analyses were performed according to AOAC standards.

**Result:** Ewes fed the 8.33REB, 25REB, 16.6REB, 16.6REBsc rations had lower serum levels for the majority of biochemical parameters compared to the 33CON control group. The results indicated that serum glucose, aspartate aminotransferase and urea decreased slightly in the groups supplemented with date waste and *Saccharomyces cervicea* (P<0.05) whereas, albumin and cholesterol were marginally significant. Therefore, date waste could be distributed, partially to ewes as an alternative to concentrate.

**Key words:** Datewaste, Ewes, Metabolic profiling, *Saccharomyces cerevisiae*.

## INTRODUCTION

In Algeria, sheep number is estimated more than 29 million head and rearing a strategic sector for improving food security (FAO STAT 2019). However, the needs of sheep in food to maintain them in good health and express their potentialities have increased, because of climate change, which has induced chronic or seasonal malnutrition and has largely led to a deficient productivity of this species.

It is therefore necessary to make changes to this animal production system and think about replacing sheep feed by using and enhancing available local feed resources, which can be an opportunity to reduce import costs. Consequently, date palm by-products could offer a significant reserve of ruminant's feed (Lakhdari *et al.,* 2022; Abaidia *et al.,* 2020; Boukhris *et al.,* 2017; Djaalab *et al.,* 2016; Meradi *et al.,* 2016; Boudechiche *et al.,* 2010; Chahma *et al*., 2004).

In steppes and sub-Saharan areas, date waste can substitute for concentrate and can be consumed by ruminants in times of starvation. This by-product has a high-energy value and could be interesting as an alternative feed for lactating ewes, which milk production is mainly influenced by diet during this period, since the first weeks of lactation are characterized by a significant energy deficit (De Vries Veerkamp *et al*., 2000). In addition, the determination of the metabolic profile of ewes is essential to determine the nutritional status and prevent metabolic diseases that disrupt production and reproduction (Balikci *et al*., 2007) and represents a good way to assess the health of farm animals as well as their physiological, nutritional and pathological state (Etim *et al*., 2013). However, relatively in Algeria few studies have been conducted on the effect of feed practically by product, on blood biochemical parameters.

Therefore, present study aims to determine the effect of the substitution of concentrate by date wastes at different

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proportions and the addition of brewer's yeast (*Saccharomyces cervicea*) on the biochemical parameters, in the Algerian breed Ouled Djellal at early and late lactation.

## MATERIALS and METHODS

### Animal selection, diet and experimental protocol

The study was carried out from January to April 2022 and it was conducted in a public farm (El Baraouia) located in the municipality of El-Khroub, Wilaya of Constantine (Algeria) presented in (Fig 1), on 30 ewes of the Ouled Djellal breed, multiparous and primiparous, aged from 2 to 4 years with a weight average of 62.92 kg ± 5.10. The ewes were treated with an internal antiparasitic and vitamins administered by intramuscular injections, before the beginning of the experiment and were identified separately and randomly distributed according to the ration administered into 5 groups: a control and 4 experimental groups composed evenly of 6 ewes.

All ewes received wheat straw (1 kg/ewe). In addition to wheat straw, the control group (33.3CON) received 33.3% concentrate, the 2nd group (8.33REB) received 25% concentrate and 8.33% date waste, the 3rd group (25REB) received 8.33% concentrate and 25% date waste, the 4th group (16.6REB) received 16.6% concentrate and 16.6% date waste and the 5th group (16.6REBsc) received the same diet as the 4th group in addition to 2 g of *Saccharomyces cervicea* (Table 1). The animals were subjected to a 15-day adaptation period during which date waste and brewer's yeast were gradually introduced into the rations. Food was distributed once a day each morning. The study was carried out over a period of 120 days, extended from the 4th month of gestation until one month and half of lactation.

### Chemical analyses of food

The chemical composition of the three foods was determined according to AOAC (1990) standards, after grinding using a 1 mm grid. The analyses were carried out in duplicate and triple repetition. The dry matter (DM) content was determined after drying the samples in an oven at 105°C for 4 hours. Mineral matter (MM) and organic matter were defined after calcining foods in a muffle furnace (AOAC, 1999) at 550°C for 6 hours. The content of foods in total nitrogenous matter (MAT) was characterized according to the Kjeldahl method (AOAC, 1995) using a Kjeldahl apparatus (Mineralization: BUCHI Speed Digester K-439 (AOAC1999)/Distillation: BUCHI 043500). The crude fiber (CB) was fixed by the Wendee method (AOAC, 1995) using a fibertech 1999/ VELP SCIENTIFICA- FIWE RAW FIBER EXTRACTOR. In addition, the fat (MG) was defined with a soxhlet extractor Foss Soxtec TM 2043, Neutral detergent fibers (NDF), acid detergent fibers (ADF) and acid detergent lignin (ADL) were determined according to the method of Van Soest *et al.* (1991) using a Fibertech (VELP SCIENTIFICA-FIWE RAW FIBER EXTRACTOR).

### Biochemical analysis

Blood samples were taken by puncture of the jugular vein in the morning on an empty stomach, in vacutainer tubes under vacuum heparinized and centrifuged at 3000 rpm/ 15 min. All samples were then frozen at -20°C until analysis. Biochemical parameters including creatinine, urea, total cholesterol, triglycerides, Aspartate amino-transferase,

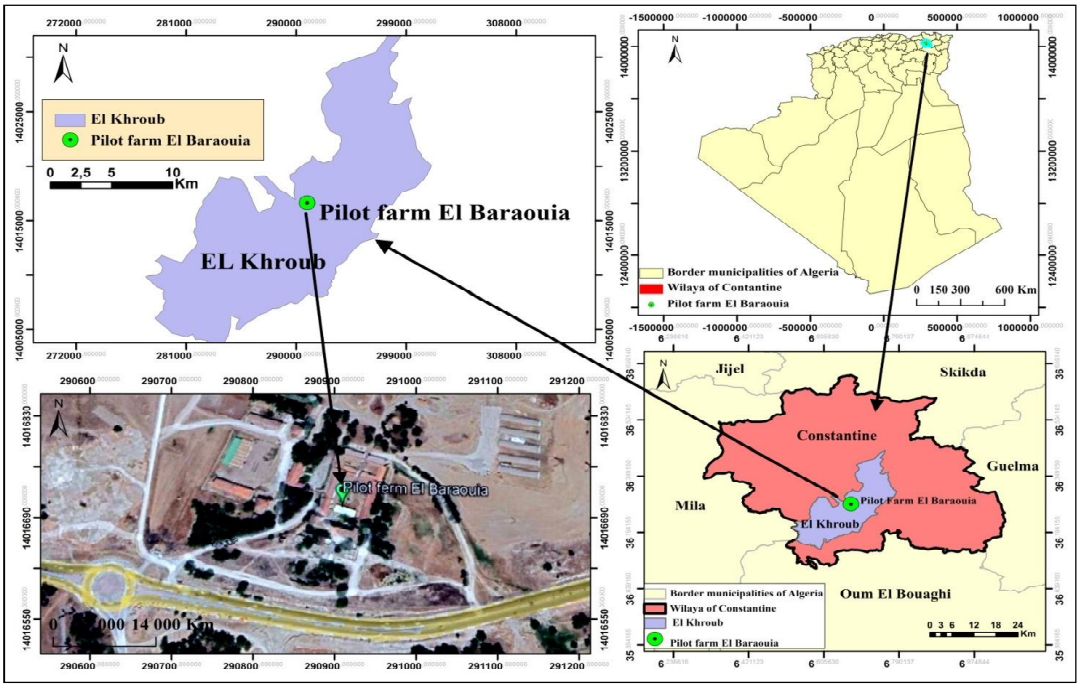


**Fig 1:** Location map of the pilot farm El Baraouia (wilaya of Constantine).

Alanine amino-transferase, albumin, total protein and glucose were determined by ultraviolet spectrophotometry using an automaton (Siemens Health Care ADVIA® 1800), at the Biochemistry Laboratory of the Center Hospitalo-University of Constantine.

### Statistical analysis

The data obtained were analysed by the XLSTAT 2018.1.1. A descriptive analysis was carried out, followed by an analysis of variance (One-Way ANOVA). In case of variation, a Newman-Keuls test at a threshold of 5% was used, in order to highlight the homogeneous groups. Differences were considered significant at $P<0.05$.

## RESULTS AND DISCUSSION

### Chemical analysis

The results of the chemical composition of the 3 foods analyzed are presented in Table 1, it shows that the fat content (EE) is very low for all feed and varies between 1.48 to 2.95%. These values are in the recommended range since the fat content exceeding 6-7% reduces fiber digestion and therefore DM intake in dairy ewes (NRC, 2007). The neutral detergent fiber (NDF) and acid detergent fiber (ADF) content of date waste and concentrate are almost similar and vary between 32.5-33.8% and 28.1-28.7% respectively, while wheat straw showed the highest value (68 and 37.9%). On the other hand, the date waste analysed presented a low percentage of lignin 6.69%. As for the other parietal compounds, they are moderately low as confirmed by Boudechiche *et al.* (2010) and Boukhris *et al.* (2017). Crude fiber (CF) content is very low for date waste and concentrate with respectively 6.66% and 8.8% of dry matter, against relatively high content for straw 23.98%. Date wastes is in the range of those reported by Meradi *et al.* (2016) and Abaidia *et al.* (2020). According to Chehma *et al.* (2004), this low content may be due to the fact that the dates are rather a fruit rich in cytoplasmic sugars than in parietal carbohydrates.

On the other hand, these foods are poor in crude proteins, especially for date waste with a value of 4.28%. This result is slightly higher than those reported by Boudechiche *et al.* (2010) and Abaidia *et al.* (2020) who respectively recorded 3.2% and 2.4% content. Table 2 represents the physico-chemical composition of the five rations distributed to the ewes. The contents of the 5 rations in DM, OM, Ash, EE, NDF, ADF, Cellulose, Hemicellulose and CF, are almost similar. On the other hand, the five rations had a low CP content (7.16% to 5.69%). The 16REBsc ration presented a total nitrogenous matter content of 7.16% with the addition of 2 g/ewe/d *Saccaromyces cerevisiae*, similar to the CP content of the 33.3CON ration. Lesmeister *et al.* (2004), have recorded the following values of total soluble nitrogenous matter: 16.8% for 0%, 18% for 1% and 17% for 2%, after the addition of *Saccaromyces cerevisiae* to 1% and 2% of the starter ration of dairy calves. According to Hassan and Mohammed (2016), the increase in CP levels is due to *Saccharomyce cervicea* stimulating factors, such as amino acids and peptides that increase the number of cellulolytic bacteria and reduce the negative effects associated with high-dose diets.

### Analysis of serum biochemical parameters

The results of the biochemical concentrations of lactating ewes according to the distributed rations are presented in Table 3. The average levels of biochemical parameters in this present study are within the range of the results reported in the literature for Ouled Djellel lactating ewes (Boudebza *et al.,* 2022; Titaouine *et al.,* 2017; Djaalab 2017; Haffaf *et al*., 2012 and Deghnouche *et al.,* 2011). The results indicated that there is a significant difference in aspartate aminotransferase level in early lactation ($P<0.05$) and creatinine ,urea, aspartate aminotransferase, glucose in late lactation ($P<0.05$) depending on the addition of date waste and *Saccharomyces cervicea* in the rations.

The overall mean serum creatinine values at the beginning and at the end of lactation were (7.85-7.97 mg/l)-(8.86-9.45 mg/l)-(9.81-9.43 mg/l)-(8.31-10.02 mg/l)-(8.97-

**Table 1:** Chemical composition of food.

| Chemical composition % DM | Concentrate | Date waste | Wheat straw |
|---|---|---|---|
| Humidity (H%) | 9.14 | 8.7 | 12.33 |
| Dry matter (DM) | 90.86 | 91.34 | 87.69 |
| Fatty matter (FM) | 2.95 | 1.48 | 2.37 |
| Organic matter (OM) | 97.29 | 95.87 | 93.62 |
| Mineral matter (MM) | 2.7 | 4.12 | 6.37 |
| Crude proteins (CP) | 10 | 4.28 | 5.68 |
| Neutral detergent fiber (NDF) | 33.8 | 32.5 | 68 |
| Acid detergent fiber (ADF) | 28.7 | 28.1 | 37.9 |
| Acid detergent lignine (ADL) | 11.7 | 6.69 | 5 |
| Crude fiber (CF) | 8.8 | 6.66 | 23.98 |
| Cellulose | 17 | 21.41 | 32.9 |
| Hemicellulose | 5.1 | 4.4 | 30.1 |

10.04 mg/l) in the 33.3CON, 8.33REB, 25REB, 16.6REB and 16.6REBsc groups and period respectively. Our results show that in early and late lactation, the serum creatinine levels of ewes supplemented with date wastes at different proportions and/or with the date wastes-*Saccharomyces cervicea* mixture tends to be always higher than those observed in the 33.3CON controls. The analysis of variance showed a significant effect (P<0.05) of this parameter only at the end of lactation in the 33CON, the serum creatinine is higher in the ewes of the 16.6REBsc with *Saccharomyce cervicea* supplementation and the 16.6REB. According to Silva *et al*. (2015), creatinine level in ewes was higher with a concentrate supplementation at 0.5% of BW (69.07 µmol/L) compared to 1.5% of BW (63.14 µmol/L), due eventually to energy deficiency condition and to severe conditions of mobilization of body proteins. Our results agree with those of Meena *et al*. (2021), who revealed a non-significant effect on serum creatinine, after supplementation with *Saccharomyce cervicea,* with low values varying between 5.89 mg/l and 5.91 mg/l. Nevertheless, the serum creatinine

**Table 2:** Chemical composition of the rations distributed to ewes.

| Chemical composition % DM | Ration 8.33% REB | Ration 25% REB | Ration 16.6% REB | Ration 16.6% REBsc | Control ration 33% CON |
|---|---|---|---|---|---|
| Humidity (H%) | 11.23 | 11.16 | 11.18 | 11.18 | 11.27 |
| Dry matter (DM) | 88.78 | 88.86 | 88.7 | 88.7 | 88.74 |
| Ether extract (EE) | 2.45 | 2.2 | 2.32 | 2.32 | 2.57 |
| Organic matter (OM) | 94.72 | 94.48 | 94.47 | 94.47 | 94.83 |
| Mineral matter (MM) | 5.27 | 5.5 | 5.38 | 5.38 | 5.15 |
| Crude proteins (CP) | 6.64 | 5.69 | 6.16 | 7.16 | 7.12 |
| Neutral detergent fiber (NDF) | 56.49 | 56.27 | 56.33 | 56.33 | 56.59 |
| Acid detergent fiber (ADF) | 34.78 | 34.68 | 34.69 | 34.69 | 34.83 |
| Acid detergent lignine (ADL) | 6.82 | 5.98 | 6.39 | 6.39 | 7.23 |
| Crude fiber (CF) | 18.74 | 18.38 | 18.55 | 18.55 | 18.92 |
| Cellulose | 27.96 | 28.7 | 28.31 | 28.31 | 27.6 |
| Hemicellulose | 21.71 | 21.59 | 21.64 | 21.64 | 21.76 |

Ration 33.3% CON : Wheat straw + concentrate (66.66% : 33.33%), Ration 8.33% REB : Wheat straw + concentrate and date waste (66.66% : 25% : 8.33%), Ration 25% REB : Wheat straw + concentrate and date waste (66.66% : 8.33% : 25%), Ration 16% REB: Wheat straw + concentrate and date waste (66.66% : 16.66% : 16.66%), Ration 16.6% REBsc: Wheat straw + concentrate + date waste + *Saccharomyce cervicea* (66.66% : 16.66% : 16.66% : 2 g *Saccharomyce cervicea*/ewes).

**Table 3:** The variation of biochemical parameters in relation to the incorporation of date waste and *Saccharomyces cervicea* into the ration.

| Biochemical parameters | Physiological status | 8.33 REB | 25 REB | 16.6 REB | 16 REBsc | 33 CON | P |
|---|---|---|---|---|---|---|---|
| Creatinine (mg/l) | Early lactation | 8.86±0.56a | 9.81±1.42a | 8.31±1.04a | 8.97±1.94a | 7.85±1.40a | 0.469 |
| | Late lactation | 9.45±0.30a | 9.43±0.85ab | 10.2±1.17a | 10.04±0.93a | 7.97±0.42b | 0.045 |
| Urea (g/l) | Early lactation | 0.14±0.03a | 0.22±0.08a | 0.18±0.11a | 0.16±0.06a | 0.21±0.08a | 0.633 |
| | Late lactation | 0.17±0.03b | 0.23±0.06b | 0.18±0.06b | 0.17±0.09b | 0.43±0.09a | 0.005 |
| Cholesterol (g/l) | Early lactation | 0.64±0.09a | 0.63±0.15a | 0.61±0.17a | 0.57±0.13a | 0.76±0.09a | 0.447 |
| | Late lactation | 0.74±0.06b | 0.75±0.04b | 0.87±0.04a | 0.73±0.10b | 0.76±0.04b | 0.084 |
| Triglyceride (g/l) | Early lactation | 0.20±0.06a | 0.19±0.05a | 0.14±0.06a | 0.14±0.06a | 0.16±0.02a | 0.423 |
| | Late lactation | 0.26±0.11a | 0.28±0.10a | 0.24±0.05a | 0.16±0.05a | 0.23±0.10a | 0.491 |
| Aspartate aminotransferase | Early lactation | 78.37±12.60b | 85.33±17b | 85.14±13.82b | 86.61±19.55b | 117.64±10.72a | 0.043 |
| (IU/l) | Late lactation | 77.86±4.47b | 78.71±8.04b | 96.09±16.73ab | 90.66±14.86b | 123.78±24.82a | 0.027 |
| Alanine aminotransferase | Early lactation | 12.45±2.03a | 15.13±2.35a | 13.68±1.82a | 16.54±1.82a | 16.20±2.35a | 0.573 |
| (IU/l) | Late lactation | 18.26±2.33a | 14.54±3.82a | 17.38±5.43a | 21.05±5.90a | 19.26±2.54a | 0.470 |
| Albumin (g/l) | Early lactation | 27.59±2.75a | 28.98±3.57a | 26.41±4.78a | 28.30±5.32a | 30.74±1.08a | 0.688 |
| | Late lactation | 30.25±2.52b | 30.74±1.27b | 29.36±2.03b | 30.84±1.35b | 34.07±1.22a | 0.066 |
| Proteins (g/l) | Early lactation | 65.99±6.04a | 71.33±2.57a | 58.91±9.07a | 66.89±8.19a | 70.71±2.16a | 0.132 |
| | Late lactation | 73.98±10.71a | 79.21±1.60a | 72.54±5.07a | 77.18±3.32a | 82.84±4.80a | 0.291 |
| Glucose (g/l) | Early lactation | 0.54±0.03bc | 0.62±0.09ab | 0.52±0.07c | 0.58±0.04abc | 0.65±0.04a | 0.030 |
| | Late lactation | 0.63±0.06a | 0.72±0.11a | 0.62±0.02a | 0.65±0,06a | 0.72±0.05a | 0.248 |

[abc] Means in the same row without common letter are different at p<0.05.

values are mostly within the range of normal serum creatinine values in ewes reported in the literature (Deghnouche *et al.,* 2011; Titaouine *et al*., 2017 and Haffaf *et al.,* 2012).

The concentration of uremia increased in a significant way (P<0.005) at the end of lactation, affected by the 33.3CON ration (0.43 g/l) compared to the other rations (8.33REB (0.17 g/l), 25REB (0.23 g/l), 16.6REB (0.18 g/l) and 16.6REBsc (0.17 g/l) and in non-significant way in early lactation. Laghrour *et al*. (2020) also recorded an increase in serum urea upon the increase of concentrate level in the ration, they reported a higher level than that found in our study (0.818 g/l). Whereas, Silva *et al.* (2015) showed an inversely proportional relationship to concentrate supplementation level. According to Grizard *et al*. (1979), there are significant linear relationships between uremia and dietary energy and nitrogenous matter intakes and between uremia and blood glucose levels and those increases in uremia, are due to increased functioning of the urea cycle in the liver, which may have two causes: increased amino acid catabolism and reduced ammonia utilization for bacterial protein synthesis in the rumen.

At the early lactation, the cholesterol level was non-significant in all groups 8.33REB, 25REB, 16.6REB, 16.6REBsc and 33CON respectively (0.64 g/l-0.63 g/l-0.61 g/l-0.57 g/l-0.76 gl), even though it tends to be lower in the group of ewes supplemented with date waste and *Saccharomyces cerevisiae* (16.6REBsc). Djaalab (2017) reported lower levels of cholesterol level than those recorded in our study. Further, they observed a significant increase of blood cholesterol level, in females receiving 25% waste dates without *Saccharomyces cervicea* (0.63 g/l) in comparison to females ingesting 50% (0.41 g/l). Nevertheless, our results remain lower than those revealed by Boudebza *et al*. (2016) in lactating ewes with (1.59 mmol/l). Laghrour *et al.* (2020), suggest that the augmentation in cholesterolemia varies with the increase in concentrate in the ration. On the other hand, Masek *et al.* (2008) observed that the values of cholesterol tended to be higher in the groups treated with *Saccharomyces cerevisiae.* Furthermore, Dobicki *et al*. (2005) showed that it reduced the total cholesterol in the blood serum of calves.

Aspartate aminotransferase content in both early and late lactation (p<0.05) is significantly high in ewes ingesting the 33.3CON diet, compared to 8.33REB, 25REB, 16.6REB and 16.6REBsc diets respectively (117.64-123.78IU/l vs 78.37-77.86IU/l vs 85.33-78.71IU/l vs 85.14-96.09 IU/l vs 86.61-90.66-IU/l). Accordingly, the partial substitution of the concentrate by date waste reduced the serum level of AST, this finding is also confirmed by Djaalab (2017), who reported a significant decrease in plasma AST (42.80 IU/l in ewes consuming 50% date wastes). Antunovic *et al*. (2004) suggested that the high activity of AST could correspond to a protein deficit and an energy supplementation of the ration in relation to a high metabolic activity of the liver. On the other hand, AST was not affected by *Saccharomyces cerevisiae* supplementation, which is in agreement with the results of Mašek *et al.* (2008); Soren *et al.* (2013).

Plasma albumin and total protein content, in early and late lactation presented non-significant differences in all diets. However, total protein parameter increased proportionally with the increase of the proportion of date wastes in the ration as well as of *Saccharomyces cerevisiae*, while comparing the values in the two groups 16.6REBsc and 16.6REB. Hypoproteinemia in 16.6REB group, eventually compensated by the addition of *Saccharomyces cerevisiae* in 16.6REBsc. El-Katcha *et al*. (2016) showed that there is a positive correlation between total serum protein and protein content of food. Onochieosita *et al.* (2020) and Galip *et al.* (2006), reported that total proteins were significantly higher, due to *Saccharomyces cerevisiae* supplementation, since the addition of yeast of beer in the ration stimulates microbial activity by increasing the incorporation of nitrogen into microbial proteins resulting in an increase in protein digestibility (Abdel-Khalek *et al*., 2000). Total protein and total serum albumin values were within physiological limits as reported respectively by Laghrour *et al*. (2020) (70.4 g/l, 31.9 g/l) and by Safsaf *et al.* (2012) (69.17 g/l, 30.60 g/l) and higher than those reported by Deghnouche *et al*. (2011) (64.19 g/l, 24.54 g/l) and by Djaalab (2017), using a ration containing date wastes (35.60 g/l, 18.76 g/l).

The glycaemia content at the beginning of lactation was significant (p<0.05) in the control group (33.3CON) with a higher content (0.65 g/l) followed by 25REB (0.62 g/l), 16.6REBsc group (0.58 g/l), 8.33REB (0.54 g/l) and 16.6REB group (0.52 g/l). A significant hypoglycaemia of the groups supplemented with date waste compared to the control 33.3CON group is noted, even though it remains within physiological standards Simpraga *et al*. (2013) (0.43-0.83 g/l). According to Chachoua (2015), this decrease is due to the fact that the food ration as a less energy, which can justify the difference in the concentration of glycemia between the rations. On the other hand, Djaalab (2017), justified the notable hypoglycemia of the ewes supplemented with 25 and 100% date wastes, results as well from an insufficient energy supply in the feed ration, due eventually to the indigestibility of the dietary fibers thus reducing the activity of the ruminal biomass. El-Tawab *et al*. (2016) reported a significant increase in glucose concentration in lactating goats and ewes after probiotic supplementation. Furthermore, no change in glycaemia has been reported after yeast supplementation in calves (Lesmeister *et al.,* 2004).

## CONCLUSION

This study indicates that the substitution of concentrate with date wastes at different proportions (8.33REB, 25REB, 16REB and 16.6REBsc) showed almost the same nutrient content as the control group (33CON). The biochemical parameters of ewes of the Ouled Djellel breed were influenced by the partial substitution of the concentrate by date waste in association with *Saccharomyces cervicea*, by significantly affecting serum creatinine, urea, Aspartate

amino-transferase and glycemia. From our results, the replacement of concentrate by date wastes at different proportions and the addition of *Saccharomyces cervicea* could be an important mean to provide sheep diets with a low price. More investigations have to be done by testing higher level of *Saccharomyces cervicea* to search their eventual effects on the production performances of ruminants.

**Conflict of interest:** None.

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