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# Techno-economic effects of energy and nitrogen supplementation on the weight performance of Peulh Peulh rams*

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***Peulh Peulh rams** is household sheep breed in Senegal

**ABSTRACT**

In Senegal, the alternation between a short rainy season (3 months) and a long dry season (9 months) results in strong qualitative and quantitative variations in the nutritional value of fodder which rarely responds to the demands of the animals throughout the entire season. year. This work contributes to studying the technico-economic effects of energy and nitrogen supplementation on the weight performance of Peulh Peulh rams. It involved a total of thirty (30) rams with two adult teeth, with an initial average live weight of 27.04 kg distributed according to a random device in six (6) groups of 5 subjects kept in permanent stabling. The six (6) batches of animals each correspond to six (6) food treatments composed respectively of untreated straw (control) (T0), untreated straw + multinutrient blocks (T1), untreated straw + the processed feed (T2), untreated straw + multinutrient blocks + milled feed (T3), 5% urea treated straw (T4) and urea treated straw + milled feed (T5) . The results showed that over the three months of testing, including the adaptation phase, the energy and nitrogen supplementation of the rams significantly increased the live weight (PV), the mean daily gain (ADG), the mean ingestion. individual straw (IMIP) and individual water consumption (IEC) in subjects. The best average daily gains were in decreasing order of importance recorded in lots T5, T3, T2, T1, T4, T0 (control lot). However, the results showed that the weight performance of the rams having received the T1 and T4 treatments was superior to that of the T0 control treatment, but this difference is not significant ($p > 0.05$). The rams having benefited from the T5, T3 and T2 treatments had statistically superior weight performances ($P < 0.05$) to others. Likewise, the T4 treatment is economically more profitable than the others.

## I. INTRODUCTION

The development of animal husbandry is closely linked to environmental conditions and more specifically to the climate, which has a decisive influence on agricultural production in tropical countries in general, Sahelian countries in particular. Livestock farming as practiced in Senegal is essentially based on traditional pasture exploitation (Claude et al., 1991) [**1**]. The alternation between a short rainy season (3 months) and a long dry season (9 months), results in strong qualitative and quantitative variations in the nutritional value of the fodder which is generally not all year round (Valenza and Fayolle 1965,[**2**]; Calvet et al., 1976,[3] , 1974[4], 1965 [5], Suttie, 2004**[6]**. One of the constraints linked to pastures remains their lack of legumes, the nitrogen value of which is relatively independent of the agro-climatic context (Guérin, 1999) [**7**].

Sheep breeding is of paramount importance in Senegal given religious and customary events including the feast of Tabaski (eid el kabir). Much effort is being made by the State through the ministry in charge of livestock in relation to market supply, despite everything a deficit is recorded especially in the regions of Dakar and Thiès. In this context there is a need to carry out studies in order to contribute to the development of the Tabaski sheep which mainly concerns the ram. These studies focus on improving livestock feeds in order to control loads on the feed supply on the one hand and increase body weight on the other hand.

Lack of control over pastoral resources is the cause of low livestock productivity and leads breeders to prioritize the number of heads over quality. Watering is done at temporary ponds in the rainy season and at hydraulic structures in the dry season. These hydraulic structures are managed by organizations [**8**](Luxie, 2011).

The only fodder resource available in the dry season is bush straw. However, the nutritional value of this dry season straw gradually decreases and is no longer able to cover the maintenance needs of the animals in terms of energy and nitrogen supplies. This leads to deterioration in the general condition of the sheep and therefore a considerable decrease in the production of Tabaski sheep.

Farmers realized early on that more animal feeds are needed to improve the overweight condition of male sheep intended for meat production. Thus, the traditional extensive farming method coexists more and more with a semi-intensive system for pastoralists who plan to conduct Tabaski operations, that is, sell rams for the Tabaski festival. This semi-intensive system consists of supplementing the animals with concentrated feed when they return from pasture. This method of breeding can be termed sheep fattening.

The breeder must know the type of end product desired, the time required to produce it, and the income he hopes to make from the sale of his animal before starting fattening. Depending on his objectives, he will decide both the breed and the category of sheep to be fattened and the form of fattening to practice

The state of health is also a significant factor in the production of meat. Indeed, any physiological disturbance has a negative impact on weight growth.

This is the context in which our article, the objective of which is to study the technical and economic effects of supplementation on the weight performance of Peulh-Peulh rams, is placed. The study consists of verifying the weight change of rams through the use of multi - nutritional blocks (BMN) and urea treated straw and analyzing the financial profitability.

## II. MATERIALS AND METHODS

### 2-1. Study site

The study site is the Dahra Zootechnical Research Center located in the Sylvopastoral Zone (ZSP). It is a vast eco-geographical area that straddles the regions of Louga, Saint Louis and Matam.

### 2-2 Animal material

The animal material is composed of Peulh Peulh sheep. It belongs to the group of sheep from the western Sahel and is found in central Senegal in the Sylvopastoral zone.

The sheep used for the experiment are all male, with two (2) adult teeth, therefore having an average age of about 18 months with an average weight of 27.04 ± 0.36 kg on arrival. The choice of sheep purchased is guided by compliance with the principle of homogeneity in classic experimentation.

These criteria for choosing sheep based on homogeneity depend, in addition to the experimental set-up, on the object of the study, which relates to weight growth. These criteria covered: the body condition of the animal, age, sex, size and breed which influence the live weight of the animal.

### 2-3 Data collection

Individual monitoring sheets were used for recording data (animal weight, quantities of solid or liquid food distributed and refused). A notepad is used to clearly diagram the device so that it can be used in the field for treatments. Markers are used to identify sheep by letters. A SONY brand digital camera is used to take pictures to better illustrate the facts about the protocol.

### 2-4 Data processing and analysis

Excel software (Microsoft Office) is used for the computer entry of raw data and preliminary processing. The MINITAB software (version 17) was used to perform descriptive and inferential statistical analyzes.

The data collected on weight and food consumption were the subject of descriptive statistical analyzes (calculation of means and standard deviations) and inferential (analysis of variance or ANOVA), followed by the separation of the means by the Tukey method. for the separation of means in case of significant differences

### 2-5 Experimental setup

The aim is to test the effect of supplementation on the weight growth of Peulh Peulh rams having received bush straw, whether or not treated with urea, as a staple food. The food supplement provided consists of processed food and multi - nutritional blocks. To do this six (06) treatments were studied namely:

T0: Contribution of untreated straw alone (PNT) or control;

T1: Supply of untreated straw + multi-nutritional blocks (PNT + BMN);

T2: Contribution of untreated straw + processed feed (PNT + AU);

T3: Contribution of untreated straw + multi-nutritional blocks + milled feed

(PNT + BMN + AU);

T4: Contribution of straw treated with urea (5%) alone (PTU);

T5: Contribution of straw treated with urea (5%) + milled feed (PTU + AU).

A Completely Random Device (DCA) or simple randomization was used. The 30 sheep were divided into six (06) batches of five (05) subjects, each batch corresponding to one of the 6 treatments defined above. Each sheep in a batch is considered a repeat.

Also throughout the test, the animals were kept in stalls.

**2-6 Economic study**

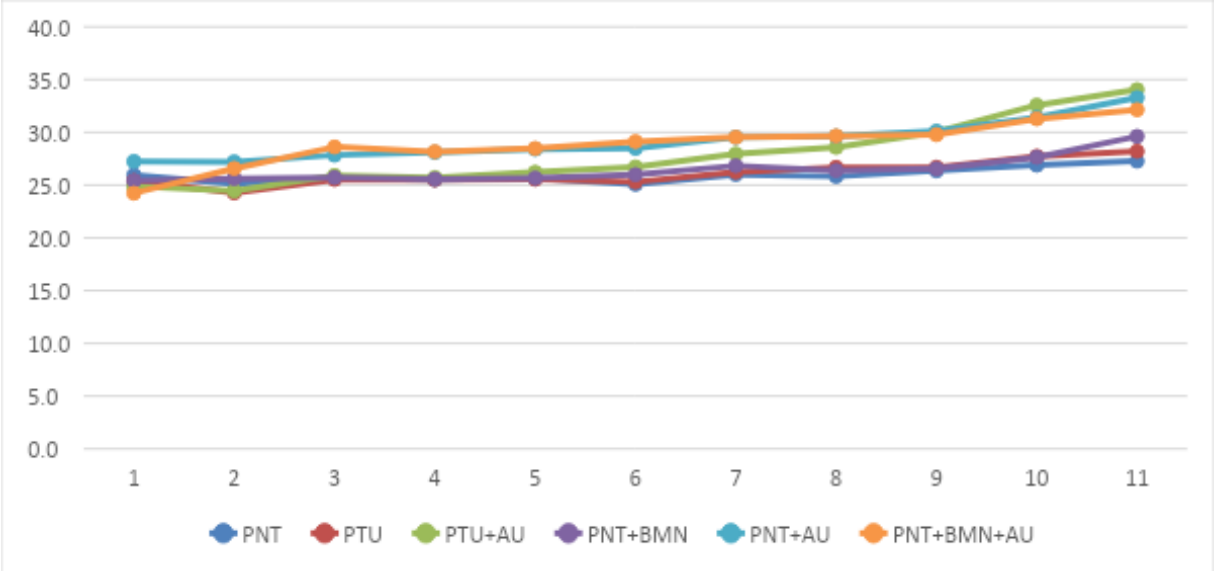
An operating account is drawn up from all the information collected on expenses and revenues. The technical depreciation of equipment is not taken into account in this exercise. The gross operating income is calculated by the difference between the gross product and the variable costs for each batch. Then the marginal rate of return for each treatment is analyzed.

## III. RESULTS

**3-1 Weight evolution of the animals after the adaptation phase and according to the treatment**

The results (Figure 1) show that the weight development of the animals is positive for all the treatments. The weight growth curve of the sheep by food treatment during the eleven (11) weeks of testing, and after two (2) weeks of adaptation (figure 2) shows that the live weights of the sheep having received the treatments: T0, T4, T2 and T1, evolve in a similar way from the beginning to the 7th week of the test. Then from the 7th week, a higher weight growth is noted in the subjects of the T5 treatment. It is followed by the animals of the T1 treatment from the 10th week, then those of T4 and those of the control treatment T0 which had the weakest growth. The live weights of the sheep of the treatments: T3 and T2, evolve in a similar way also from the 2nd week until the 10th week. The results also show that the live weights of the sheep subjected to the treatments: T3 and T2, are higher compared to the live weights of the other sheep during the phase from the 2nd week to the 9th week. However, from week 9, we find that the live weights of the animals having received the T5 treatment show the highest values during the remaining three (3) weeks of the test. Finally, from the point of view of the change in weight growth, it is easy to see that the results obtained are generally satisfactory for all the treatments carried out.

**Figure 1:** Weight evolution of the animals according to the treatments after the adaptation phase

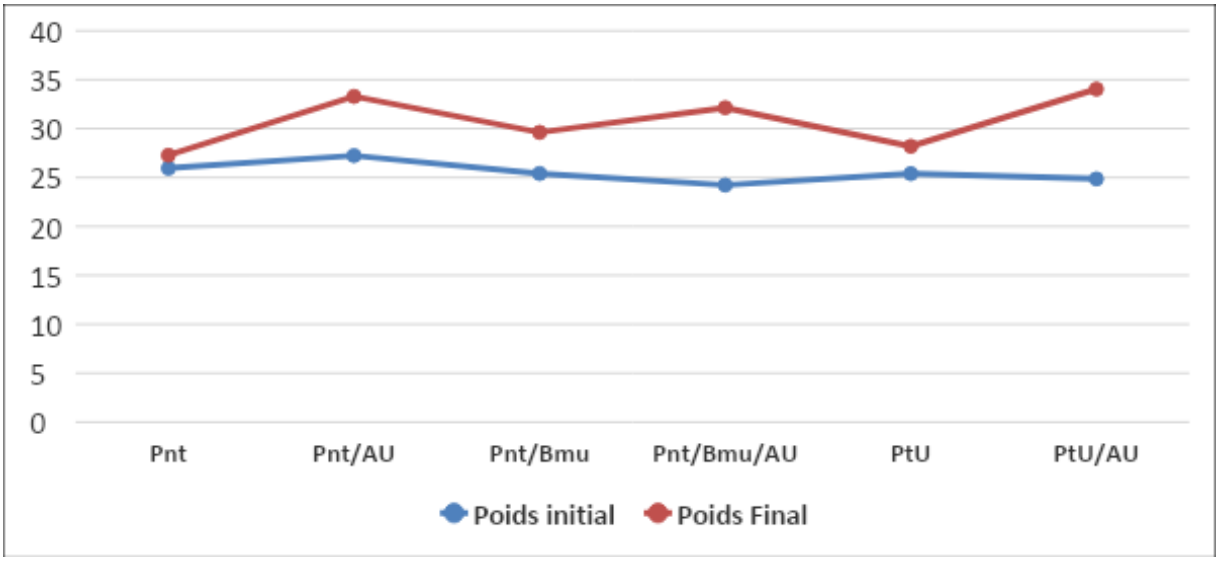



**Source :** Authors' calculation

### 3-2 Effect of supplementation on final animal weights

The animals increased in weight at the end of the experiment (Figure 2). The live weights of animals supplemented with processed feed are higher than those of animals treated without processed feed. It is noted that supplementation with multi-nutritional blocks increased the weight of the animals more than supplementation with treated straw. These results are different from those of the adaptation period where for some treatments; the milled feed caused weight loss in sheep due to diarrhea.

**Figure 2:** Evolution of the initial weight and the final weight of the animals according to all of the treatments



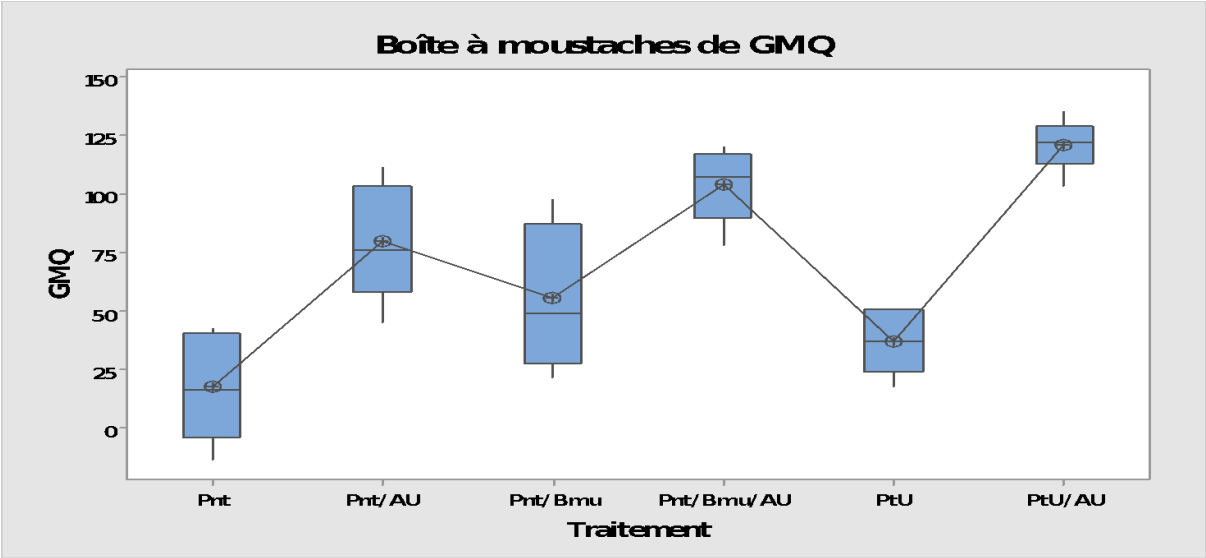

**Source:** Authors' calculation

**With :** T0= Pnt;. T1=Pnt/Bmu; T2= PnT/AU; T3=Pnt/Bmu/AU; T4= PtU; T5=PtU/AU

**3-3 Average daily gain (ADG) after the adaptation phase**

**Figure 3** and Table 1 show the comparison of the mean ADG of sheep by Tukey's method with a confidence level of 95%. The results showed that the means of the ADGs of the animals of the treatments: T5, T3 and T2 are not significantly different (p> 0.05) and are the highest. Then the means of the ADGs of the treatment animals: T2 and T1 are not significantly different (p> 0.05).

**Figure 3** : Boxplot of sheep ADGs after the adaptation phase




**Source :** Authors' calculation

The means of the ADGs of the animals of the treatments: T0, T1 and T4 were not significantly different (p> 0.05) and were lower. Furthermore, the means of the ADGs of the animals of the treatments: T5, T3 were greater and significantly different from the means of the ADGs of the animals of the T0, T1 and T4 treatments (P <0.05).

**Table 1:** Analysis of the means of ADG of animals by the Tukey method

| **Traitement** | **N** | **Moyenne** | **Groupement** |
|---|---|---|---|
| PtU/AU | 5 | 120,79 | A |
| Pnt/Bmu/AU | 5 | 104,05 | A |
| Pnt/AU | 5 | 79,6 | A B |
| Pnt/Bmu | 5 | 55,4 | B C |
| PtU | 5 | 36,87 | C |
| Pnt | 5 | 17,4 | C |

**Source :** Calcul auteurs

Figure 4 shows the two-by-two comparison of the confidence intervals of the mean ADGs of sheep by the 95% Fisher procedure. The results presented in this figure show that the differences in the means of the ADGs of the animals of the treatments: T1-T0, T2 -T0, T3-T0, T5 -T0, T5 -T2, T3 - T1, T5 -T1, T5-T4 are positive and significantly different ($p < 0.05$).

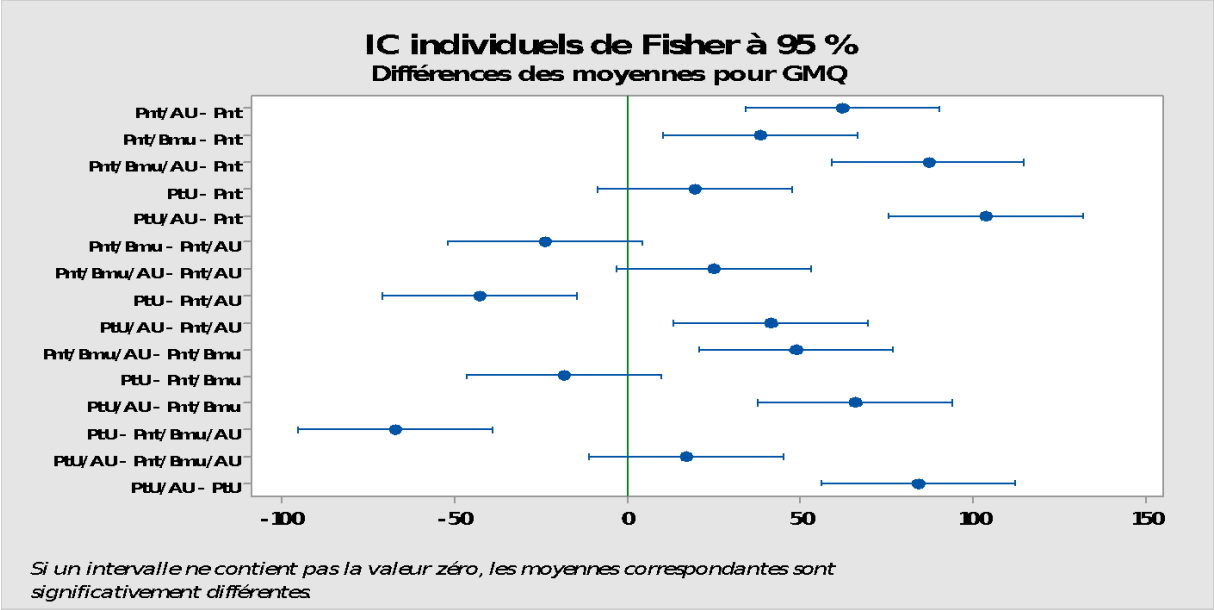
On the contrary, the differences in the means of the ADGs of the animals of the treatments: T4-T3, T4-T3 are negative and significantly different ($p < 0.05$).

The differences in the means of the ADGs of the animals of the treatments: T1-T2, T4 -T1 are negative and are not significantly different ($p > 0.05$).

The differences in the means of the ADGs of the animals of the treatments: T4-T0, T3-T2, T5-T3, are positive and are not significantly different ($p > 0.05$).

The results (Table 2) showed that the ADGs of the T5 treatment animals (120.789 g / day) were higher in the test, followed by those of the T3 treatment animals (104.053 g / day). Then come those of the animals of the T2 (79.579 g / day), T1 (55.395 g / day), T4 (36.868 g / day) treatments and finally those of the T0 control treatment animals (17.447 g / day) which had the lowest average daily earnings

**Figure 4:** Two-by-two comparison of animal ADG means by Tukey's method




**Source :** Authors' calculation

**Table 2:** Analysis of the animals' ADG according to the treatment

| Processing | Initial weight(kg) | Final Weight(kg) | GMQ (g/jr) |
|---|---|---|---|
| PNT | 25,946 | 27,272 | 17,447 |
| PNT + AU | 27,238 | 33,286 | 79,579 |
| PNT + BMN | 25,408 | 29,618 | 55,395 |
| PNT + BMN + AU | 24,234 | 32,142 | 104,053 |
| PTU | 25,396 | 28,198 | 36,868 |
| PTU + AU | 24,86 | 34,04 | 120,789 |

Source: Authors' calculation

**3-2 Economic results**

**3-2-1 Operating result**

Table 3 shows that the rams fed with urea treated straw and milled feed (T5) gave a higher net benefit with 5,957 F CFA per subject. Then come the animals fed with untreated straw plus the multi-nutritional block and milled feed (T3) with 2687 F CFA per subject. They are followed by animals fed with untreated straw plus the multi-nutritional block (T1) with 830 F CFA per subject. However, losses are recorded with animals fed with straw treated with urea (T4) with -400 FCFA per subject, less important than those obtained by animals fed with untreated straw plus processed feed (T2). -950 FCFA. Finally, we recorded a loss of -1994 FCFA by animals fed with untreated straw (T0).

**Table 3:** Operating account for the different treatments

| **Processing (ration)** | **T1 (PNT+BMN)** | **T3 (PNT+BMN+AU)** | **T5 (PTU+AU)** | **T4 (PTU)** | **T0 (témoin: PNT )** | **T2 (PNT+AU)** |
|---|---|---|---|---|---|---|
| **Operating Expenses(FCFA)** | **Rising** | **Rising** | **Rising** | **Rising** | **Rising** | **Rising** |
| Food | 4516 | 10691 | 9568 | 2979 | 1611 | 9114 |
| Animal | 50000 | 50000 | 50000 | 50000 | 50000 | 50000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Veterinary products | 2938 | 2938 | 2938 | 2938 | 2938 | 2938 |
| **Total charge(FCFA)** | **57454** | **63629** | **62506** | **55917** | **54549** | **62052** |
| | | | | | | |
| **Recipe (FCFA) :** animal sale | **58284** | **66316** | **68463** | **55517** | **52555** | **61102** |
| **Net profit** | **830** | **2687** | **5957** | **-400** | **-1994** | **-950** |

**Source:** Authors' calculation

**3-2-2 Margin rate of profitability for treatments**

The Marginal Rate of Return (TMR) allows you to compare the increase in variable costs that result from switching from one more expensive option to another with the corresponding increase in net profit. It is the ratio between the additional net profit and the additional charges expressed as a percentage. Table 4 showed that for a target rate of 100% (batch T0), we opted for the T4 treatment due to its higher TMR (116.52%) compared to the other treatments. Then comes the T5 treatment with its TMR of 101.48% then the T1 treatment with its TMR of 80.3%.

Thus, these results show that the use of straw treated with urea and multi - nutritional blocks contribute to reducing the amount of concentrates needed to feed the rams.

**Tableau 4: Calculation of the marginal rate of return**

| **Traitement** | **T5 (PTU+AU)** | **T3 (PNT+BMN+AU)** | **T1 (PNT+BMN)** | **T4 (PTU)** | **T2 (PNT+AU)** | **T0 (witness :PNT)** |
|---|---|---|---|---|---|---|
| Profit(FCFA) | 5957 | 2687 | 830 | -400 | -950 | -1994 |
| Charged (FCFA) | 62506 | 63629 | 57454 | 55917 | 62052 | 54549 |
| Dominated | no | yes | no | no | yes | no |
| Additional profit additionnel | 5127 | | 1230 | 1594 | | |
| charge | 5052 | | 1537 | 1368 | | |
| **TMR en %** | **101,48** | | **80,03** | **116,52** | | |

**Source:** Authors' calculation

## IV. DISCUSSION

The results obtained on the average daily consumption of BMN based on molasses and urea by Peulh Peulh rams aged 15 to 18 months with an average final weight of

30.759 kg and the outcome of this study was 75.091 g / day / subject with a standard deviation of 12.456. Our results for measuring the ingestion of blocks are higher (75.091 g / day> 37.218 g / day) than those found by [**9**] i.e. 37.218 g / day / subject in goats of the same mean weight (30.759).

However, the results of measuring the ingestion of blocks of 163.028 g / day / subject in sheep found by [**10**] and those of 123.036 g / day / subject in goats found by **[11**] are higher. to our results. In addition, our results are different from those found by [**12**] on breeding heifers who consumed BMUs distributed on average at a rate of 300g / day and per head, including a BMU consumption of 428g / day for F12, followed by F10 with 358g / day, F7 with 348g / day and at the end of F8, 91g / day depending on the experimental setup.

These results showed that the ingestion of the blocks is variable according to the authors. This variation could be explained mainly by the different raw materials incorporated, their proportions which influence the hardness of the blocks, their tastes and their palatability. In addition, it seems that the content of urea or molasses incorporated influences the level of ingestion of the blocks. This is confirmed by the results of [**13**] after testing the different Blocks-molasses-urea formulas at the CRZ of Dahra. The lower the urea level is consumption. But also during our test, we found that the more humid the block, the higher the ingestion.

The difference in our results with those of certain authors cited above can be explained by the simple fact that we worked on different species, or according to [**11** ] the ingestion of blocks varies with the animal species.

The results obtained with regard to the quantity of water consumed showed that the animals of the T1 treatment consumed more water (3.114 l / day), compared to the other animals applied to the control treatment, PNT alone (2.213 l / day). jr). Likewise for the average individual consumption of straw, the animals of the T1 treatment ingested more straw (577.51 g / animal) compared to those of the control T0 treatment (517.51 g / animal). These results are in agreement with the results of surveys by [**14**] at the level of the three regions (Diourbel, Fatick and Kaolack) which revealed that the use of the block resulted in an increase in appetite and of water consumption.

These results corroborate those of [**10**] who found an average ingestion of 180g DM per animal in dry ewes fed on T1, a higher consumption than that in ewes fed on PNT. Likewise our results are in agreement with those of **[15]** in Ethiopia and those of [**16]**. These results can be explained by the fact that the blocks are catalytic therefore they stimulate the thirst and appetite of animals. In addition, the presence of salt in BMN induces thirst, hence the increase in water consumption.

The results of the adaptation phase showed that animals in all treatments showed weight loss on average at the end of the phase. These reductions in the weight of the sheep can be explained by the fact that, during the adaptation phase, the rams behaved due to the change of environment, to the driving mode (attachment to the stakes), to the various manipulations (administration of drugs and other), which caused stress to the point that their consumption had dropped, which affected their body weight. In addition, dietary changes with the use of BMN, UA and PTU resulted in cases of diarrhea during this period.

The results of our trial show that the use of urea treated straw compared to untreated one improved the average daily gain. However, the difference is not significant (p> 0.05). This could be explained by the quality of the

treated straw which deteriorated during storage by the multiple openings made without covering the pit well to feed the sheep which benefit from this treatment. This led to cases of diarrhea followed by a drop in consumption and body weight of the animals. The animals in the control treatment, T0 increased in weight from the 6th week until the end of the test.

This could be explained by the quality of the straw because the one distributed is not mown at the same time and not in the same plot. It should also be noted that the molasses, the deworming agent, the stress vitamins used have a positive effect on the weight development of the animals. However, the live weights of the animals of the T4 treatment are higher than those of the T0 control treatment from the 7th week until the end of the experiment. Rams fed the urea-treated straw gained 2.802 kg live weight. These results corroborate those obtained by [**17**] Cisse et al (1998) who found that the rams fed with treated straw gained 0.6 kg of live weight at the end of its operation. In addition, according to the author, the use of treated straw significantly increased the average daily gain (ADG) of sheep.

On the other hand, the gain in live weight (1.326 kg) recorded in the animals of the control group at the end of our test is different from that found by **[17**] who showed that the rams fed with untreated straw had lost 1.3 kg of body weight on average. Similarly, [**10**] found a significant decrease ($p < 0.05$) in the weight of ewes (-2.8 kg) fed on untreated straw compared to those fed on treated straw which gained 4 kg of weight.

The T1 treatment animals recorded not significantly ($p > 0.05$) higher weight gains of 4.213 kg and an ADG of 55.395 g / d / subject than those of the T0 control treatment with a weight gain of 1.326 kg and an ADG of 17.447g / d / subject. These results are identical to those of **[10**] who found in their experiment the best weight gains in ewes fed with straw and blocks compared to those fed with straw alone. According to these authors the average weight change was 6.4 kg at the end of the test.

In addition, it was also observed in other trials, a positive effect of the distribution of molasses-urea blocks on the zootechnical performance of the animal. Thus, [**18**] report a weight variation of 10 g / d in sheep fed on untreated straw and T1 molasses-urea blocks, while animals not supplemented with blocks lost 53 g / d. Our results confirm those of [**19**] who found an ADG that varies from 73-133 g /d in Mossi and Peul breed sheep from the Yatenga region in Burkina Faso over a period of 75 days.

Regarding the economic evaluation, the results show that the animals of the PTU (T4) treatment have a marginal rate of return 116.52% higher than those of the PTU + AU T5 treatment, whose marginal rate of return is 101.48 %, followed by those of the PNT + BMN treatment with a marginal rate of return of 80.3%. He deduces from these results that supplementation with straw treated with urea or with multi - nutritional blocks are ways of reducing food maintenance or production costs by completely or partially avoiding the use of cereals and more expensive concentrate feeds, often the subject of speculation in times of feed scarcity

Thus PTU and BMN have a positive impact on the cost of feed allowing the farmer to make a profit.

## V. CONCLUSION

This study has shown that BMNs based on urea molasses and straw treated with 5% urea can help correct the many nutritional imbalances that cause the poor performance recorded in sheep flocks in the Sahelian zone. BMNs and 5% PTU can provide animal maintenance and increase meat production, if combined with little processed feed. This work constitutes a contribution to the definition of a certain number of research actions in terms of nitrogen, energy and mineral supplementation of the herd.

The multinutrient blocks tested are interesting because they combine by-products of variable flavor and palatability and are characterized by an important nutritional value (nitrogen and mineral matter). The straw treated with urea is easily diffused in rural areas. by the simplicity of its preparation. Finally, molasses-urea blocks can make a large and positive contribution to correcting the nutritional deficits experienced by most of our herd. good quality for better productivity.

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