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EFFECT OF FEED SUPPLEMENTATION BY *MORINGA OLEIFERA* LEAVES MEAL ON QUAIL (*COTURNIX* SP.) PRODUCTION PERFORMANCES IN THE SUDANO-GUINEAN ZONE OF CAMEROON

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Abstract

The present study was carried out from April to May 2018 in order to evaluate the effect of feed supplementation by M. oleifera leaves meal (MOLM) on quail (Coturnix sp.) production performances in the sudano-guinean zone of Cameroon. For this purpose, 192 quails of 21 days old with similar live weight were divided into 12 batches of 16 birds (8 males and 8 females). To a feed containing 20.18% Crude Protein and 3013.78 kcal of M E, 0, 1, 2, or 3% of MOLM was added corresponding to treatments T0, T1, T2 and T3, respectively. Each of these experimental diets was randomly assigned to 3 batches in a completely randomized design with 4 treatments repeated 3 times each. Data were collected throughout the 5 weeks of trial on growth performances, carcass and some reproductive characteristics. At the 7 weeks of the trial, 2 males, 2 females per batch were sacrificed to evaluate carcass and some reproductive characteristics. The main results showed that regardless of sex, the significantly higher (224.13 ± 30.69 g) live weight was obtained with 2% of MOLM compared to the control (203.83 ± 16.67 g). The significantly higher (4.74 ± 0.93) feed conversion ratio was obtained with the T3 treatment compared to T2 (4.24 ± 0.80 g). Carcass yield of males ranged from 70 (T2) to 73% (T3) and from 67 (T2) to 69% (T0) in females. Only whole carcass yield, relative weights of the wishbones, neck and gizzard were significantly (P<0.05) affected by MOLM. First songs in males as well as the first egg were recorded at 6 weeks age with 3% MOLM, which also induced a higher (73.01%) egg laying rate than control batch (57.14%). Treatments supplemented with 2 and 3% MOLM increased testicular weight (4.63 ± 0.34g and 5.48 ± 0.46 g respectively) compared to the control (3.54 ± 0.73 g). It has been concluded that MOLM can be used up to 3% to improve growth performance of quail in the finishing phase. Also, a 3% supplementation could be used to improve reproductive performance.

Key words: *growth, leaves, Moringa oleifera, quail.*

INTRODUCTION

Quail farming payed attention of Cameroonian farmers as a new way of diversifying sources of animal proteins, offering consumers new tastes and reinforcing the production of meat. Its low production cost associated with its small size, disease resistance, rapid growth and relatively short life cycle of up to 3 to 4 generations per year. Its high egg production from 250 to 350/female per year (Biagini, 2006; Sauveur, 1988), as well as the supposed therapeutic virtues that characterize these eggs (Tunsaringkarn et al., 2013) are the factors that favored his expansion in recent years. However, although the production of this species seems to interest some breeders, its production performance remains relatively low. This is due to the fact that its production standards are not mastered in our environment. According to surveys conducted by Katchouang et al. (2015), 60% of breeders in the Mfoundi department in Central region of Cameroon have not received formal training for their breeding. In addition, the same study shows that 86% of Yaoundé farmers would use chicken feed while the remaining 14% will prepare their own feed without any training. However, there are many unconventional food resources in Sudano Guinean zone such as *Moringa oleifera* (MO), which could provide important nutrient, vitamin and micronutrient inputs to quail by adding it to commonly used ingredients. Studies by various authors (David et al., 2012 and Olugbemi et al., 2010) have shown that *M. oleifera* leaves are rich in proteins, minerals, vitamins and amino acids such as arginine, lysine and methionine which are essential in poultry. According to several studies, the incorporation of *M. oleifera* leaves meal (MOLM) into the diets of laying hens showed a significant improvement in productivity according to Kakengi et al. (2007) and a significant increase in the weight of eggs according to Paguia et al. (2014). In Japanese quail, the best level of production performance in Algeria was obtained with 0.2% supplementation of the staple diet with MOLM (Elkloub et al., 2015). Since quail farming and nutritional need are not mastered in the Sudano-Guinean zone of Cameroon, the present study aimed to assess the effect of feed supplementation with MOLM on growth performance, carcass characteristics, and reproduction in quail will be determined.

MATERIALS AND METHODS

Study area

The study was conducted in Ngaoundéré in the Sudano Guinean zone of Cameroon. The area is located between the 6th and 8th degrees north latitude and between the 10th and 16th degree east longitude with an average altitude of 1000 m. There is one rainy season of 8 months (April to November) and a dry season of 4 months (December to March). The rainfall is between 1500 and 1800 mm/year, the average annual humidity varies between 64.1% and 67.6% and the temperatures between 23 and 32°C. (Mbogning et al., 2011).

Materials and study management

M. oleifera leaves were cut early in the morning and then dried in the shade before being transformed into powder and kept until use.

A total of 192 quails of 21 days old and average weight of 64.25 ± 3.77 g were divided into 12 similar batches of 16 subjects (8 males and 8 females). They were housed in cages made of low-meshed planks and wire mesh at a density of 28 subjects/m^2. Four experimental diets (T0, T1, T2 and T3) formulated on the basis of the level (0, 1, 2 and 3%) of supplementation of the basic diet (average of 3000 Kcal Metabolizable Energy and 20% Crude Protein) with *MOLM* in the finishing phase.

The experimental died were formulated by adding 0, 1, 2 and 3% of the feed weight by MOLM corresponding to treatments T0, T1, T2 and T3, respectively.

Each of the 4 experimental diets was randomly assigned to 3 batches in a completely randomized design with 4 treatments repeated 3 times each. Water and feed were distributed *ad libitum* throughout the 5 weeks of the study. All birds benefited from similar management conditions.

Data collection

Experimental diets were weighed at the beginning of the week and distributed daily. Leftovers of each experimental unit were weighed every 7 days using an electronic scale of 5000 g range and 1g accuracy. Weekly feed intake was calculated as the difference between the amount of feed distributed during the week and leftovers of the same week.

At the beginning of the test and every 7 days after, quails were weighed on an empty stomach in the morning using an electronic scale of 2000 g range and 0.1g accuracy. The weekly weight gain was obtained by making the difference between two consecutive live weight.

Feed intake (FI) of each week was divided by weekly average weight gain of the same period to obtain the Feed Conversion Ratio (FCR).

At 07 weeks of age, 6 males and 6 females per treatment were slaughtered and characterized according to the method described by Genchev and Mihaylov (2008) for the evaluation of the carcass. The carcass, liver, heart, gizzard, head, thigh, chest, wing and leg weight data allowed us to calculate carcass yield and relative weight of carcass parts or organs all in relation to live body weight.

Statistical analysis

Data were expressed as mean ± standard deviation. One-way analysis of variance (ANOVA) was used according to the general linear model to compare the means of the different parameters. In case of differences between treatments, Duncan test was used at 5% significance level to separate means. IBM SPSS Statistics 21.0 software was used for analyzes.

RESULTS AND DISCUSSIONS

Average production performances

The effect of MOLM supplementation on average production performance at 7 weeks

(Table 1) shows that regardless of sex, feed intake (FI) was comparable between different treatments. Live weight significantly ($P < 0.05$) varied from 203.83 ± 16.67 g (T0) to 224.13 ± 30.69 g (T2) and in females, from 213.96 ± 18.62 g (T0) at 251.66 ± 6.79 g (T2). In females and regardless of sex, the significantly highest values were recorded with T2 treatment compared with T0 treatment who were otherwise comparable to T1 and T3 treatments. In males, significantly higher live weight was recorded with control and T2 compared to T3 treatment. The observations made for the mean weekly weight gain were the same as those for live weight. Regardless of gender, the feed conversion ratio significantly ($P < 0.05$) increased from 4.24 ± 0.80 g (T2) to 4.74 ± 0.93 g (T3), treatments supplemented with 1 and 3 % MOLM and the control group were otherwise comparable ($P > 0.05$). Supplementation of MOLM did not significantly affect feed conversion ratio of the different treatments in males.

In females however, feed conversion ratio significantly ($P < 0.05$) increased from 3.51 ± 0.06 g (T2) to 4.40 ± 0.56 g (T0). the values of feed conversion ratio for T0, T1, and T3 treatments in one hand and for T1, T2 and T3 on the other hand remained similar.

Table 1. Quail average production performances basis on the experimental diets at 7 weeks of age

Trait	Production performances				
	Treatments	Total feed intake (g)	Live weight (g)	Weekly weight gain (g)	Total Feed Conversion Ratio
Female	T0		213.96±18.62^{a}	37.42±9.31^{a}	4.40±0.56^{b}
	T1		227.37±11.73^{ab}	40.78±2.93^{ab}	3.98±0.25^{ab}
	T2		251.66±6.79^{b}	46.85 ±1.69^{b}	3.51±0.06^{a}
	T3		234.90±18.53^{ab}	42.66±4.63^{ab}	3.93±0.43^{ab}
	Mean		231.97±19.00	41.93 ±4.75	3.95±0.46
Male	T0		193.70±6.35^{b}	32.36±1.85^{b}	5.05±0.45^{a}
	T1		187.40±4.27^{ab}	30.78±1.06^{ab}	5.27±0.30^{a}
	T2		196.59±5.88^{b}	33.06 ±1.47^{b}	4.98±0.12^{a}
	T3		184.04±1.86^{a}	29.94±0.46^{a}	5.55±0.11^{a}
	Mean		190.43±6.67	31.54 ±1.66	5.21±0.33
Mixed	T0	653.12±26.73^{a}	203.83±16.67^{a}	34.89±4.16^{a}	4.73±0.58^{b}
	T1	648.45±13.44^{a}	207.38±23.27^{a}	35.78 ±5.81^{a}	4.62±0.74^{ab}
	T2	658.70±11.90^{a}	224.13±30.69^{b}	39.97 ±7.67^{b}	4.24±0.80^{a}
	T3	665.79 ±20.52^{a}	209.47±30.24^{ab}	36.30±7.56^{ab}	4.74±0.93^{b}
	Mean	665.52±18.99	211.20±25.38	36.73±6.34	4.58±0.75

a, b : on the same column and for the same gender, the assigned values of the same letter are not significantly different ($P > 0.05$)

Live weight evolution and average weight gain

The evolution of the average live weight of quails (Figure 1) as a function of the supplementation rate of *MOLM* feed shows that at week 4, T2 treatment induced a live weight significantly higher (109.15 ± 17.81 g) than T3 treatment (101.4 ± 13.55 g).

At week 5, the control treatment was similar to T2 and T3 treatments and also induced significantly ($P < 0.05$) higher weights than the T1 treatment (134.8 ± 9.12 g).

By week 6 supplementation of feed by MOLM did not significantly ($P > 0.05$) affect body weight. At the end of the study, feed supplemented at 2% with MOLM induced a significantly ($P < 0.05$) higher live weight (224.13 ± 30.69 g) compared to the control treatment (203.83 ± 16.67 g).

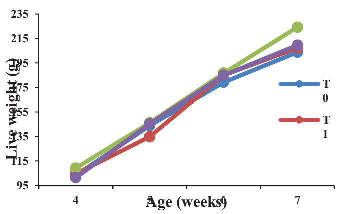

Figure 1. Evolution of weekly live weight regardless of gender based on experimental diets

Feed conversion ratio

Figure 2 shows the evolution of the Feed conversion ratio (FCR) as a function of the level of supplementation of *MOLM* in feed. Control treatment induced significantly higher ($P < 0.05$) feed conversion ratio at weeks 4 (2.75 ± 0.90 g) and 6 (5.39 ± 0.59 g) compared to the supplemented diets. At week 5, T1 induced the higher feed conversion ratio compared to other treatments which remained similar among them. At the end of the trial, the highest ($P < 0.05$) feed conversion ratio was obtained with T1 treatment (13.97 ± 8.03 g) compared to T2 treatment (7.85 ± 4.07 g) but remains comparable ($P > 0.05$) to T3 and T0 treatments.

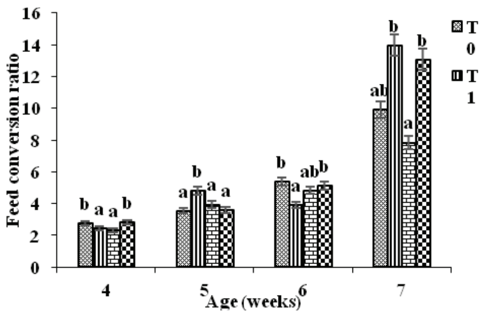

Figure 2. Weekly change in feed conversion ratio regardless of sex and based on experimental diets

Carcass yield and proportions of cuts parts

On the summarizes of the effect of *MOLM* supplementation on carcass yield of quail and the proportions (% BW) of its different cuts parts at 7 weeks (Table 2), it appears that the standard carcass yield, the proportions of thighs, wings, heads, legs and back were not significantly ($P > 0.05$) affected by the different levels of supplementation.

The highest whole carcass yields ($P < 0.05$) were obtained with diet supplemented at 1 and 2% (80.21 ± 4.23 g and 80.04 ± 3.58 g, respectively) with MOLM.

These values were also similar to that of the T3 treatment which was also similar to the control regardless of sex.

The significantly ($P < 0.05$) highest chest proportions were recorded at 1% of supplementation compared to the control and T3 treatments.

Chest proportions of T2 were otherwise similar ($P > 0.05$) to those of all other treatments. T3 treatment showed significantly higher ($P < 0.05$) neck proportions than other treatments.

Those of comparable T0 and T2 treatments did not significantly differ between them but were higher than values recorded with T1 treatment.

Table 2. Carcass yield and relative weight of different parts in relation to body weight (% BW) at 7 weeks old basis on the experimental diets

Characters (%BW)	Gender	Experimental diets			
		T0 (n=12)	T1(n=12)	T2(n=12)	T3(n=12)
Whole Carcass yield	Male	77.44±0.58^{a}	83.37±1.89^{b}	81.78 ±0.89^{b}	80.32±4.20^{ab}
	Female	74.90 ±0.94^{a}	77.0±3.36^{b}	78.32±4.72^{b}	75.03±3.90^{ab}
	Mean	76.17±1.56^{a}	80.21±4.23^{b}	80.04±3.58^{b}	77.68±4.63^{ab}
Standard carcass yield	Male	71.14 ±0.40^{a}	71.33±0.76^{a}	70.10±0.69^{a}	73.07±3.84^{a}
	Female	69.18±1.72^{a}	68.07±0.64^{a}	66.80±2.84^{a}	68.10±4.35^{a}
	Mean	70.17±1.56^{a}	69.70±1.89^{a}	68.44±2.59^{a}	70.56±4.59^{a}
Chest	Male	23.45±0.89^{a}	28.41±0.87^{b}	26.84 ±1.75^{ab}	25.41±1.39^{a}
	Female	23.60±1.99^{a}	25.99±1.35^{b}	24.12±1.05^{ab}	22.90±3.50^{a}
	Mean	23.52±1.39^{a}	27.20±1.68^{b}	25.49±1.97^{ab}	24.16±2.75^{a}
Thigh	Male	16.00±0.47^{a}	15.24±1.30^{a}	15.31±1.08^{a}	15.54±1.02^{a}
	Female	15.03±0.50^{a}	15.59±0.34^{a}	14.91±1.31^{a}	15.11±0.92^{a}
	Mean	15.52±0.69^{a}	14.41± 0.89^{a}	15.11±1.10^{a}	15.32±0.90^{a}
Wings	Male	6.14±0.23^{a}	6.52±0.42^{a}	6.18±0.30^{a}	6.26±0.42^{a}
	Female	7.02±1.12^{a}	5.51±0.42^{a}	6.22±0.75^{a}	5.97±0.35^{a}
	Mean	6.58±0.87^{a}	6.21±0.60^{a}	6.20±0.51^{a}	6.11±0.38^{a}
Neck	Male	6.13±0.64^{b}	3.74±0.40^{a}	5.22±0.40^{b}	6.81±0.48^{c}
	Female	5.82±1.19^{b}	4.21±0.37^{a}	5.07±0.66^{b}	7.66±0.86^{c}
	Mean	5.97±0.98^{b}	3.98±0.43^{a}	5.14±0.49^{b}	7.23±0.30^{c}
Back	Male	18.82±0.40^{a}	16.88±0.51^{a}	16.28±1.88^{a}	17.25±1.88^{a}
	Female	18.99±10.70^{a}	16.22±1.83^{a}	15.52±0.36^{a}	15.25±2.02^{a}
	Mean	18.91±6.78^{a}	16.55±1.25^{a}	15.90±1.28^{a}	16.60±2.28^{a}

a, b, c: on the same column and for the same gender, the assigned values of the same letter are not significantly different (P>0,05)

Relative weight of quail's organs

The effect of supplementing feed with *MOLM* feed on relative weight on some quail's internal organs at 7 weeks of age as presented in Table 3 show that the different experimental diets did not induced any significant variation on heart, liver and abdominal fat proportions.

The gizzard proportions of the control treatment were significantly the lowest compared to those of the T2 treatment and otherwise similar to other treatments. Despite the fact the Gonado-Somatic Index (GSI) of males of treatment T1 was the significantly lowest and that the values obtained with control, T2 and T3 were similar, we however noticed an increase of the GSI between T0, T1 and T2 treatments.

In females, GSI were not significantly affected ($P > 0.05$) by the level of feed supplementation by *MOLM*.

Table 3. Relative weight of some quail's organs at 7 weeks of age according to experimental diets

Characteristics (%BW)	Gender	Experimental diets			
		T0 (n=12)	T1(n=12)	T2(n=12)	T3(n=12)
Liver	**Male**	$2{,}16\pm0{,}33^{a}$	$2{,}22\pm0{,}46^{a}$	$2{,}06\pm0{,}45^{a}$	$2{,}19\pm0{,}08^{a}$
	Female	$2{,}81\pm0{,}51^{a}$	$3{,}24\pm1{,}00^{a}$	$2{,}96\pm1{,}04^{a}$	$3{,}07\pm0{,}78^{a}$
	Mean	$2{,}48\pm0{,}52^{a}$	$2{,}73\pm0{,}89^{a}$	$2{,}51\pm0{,}86^{a}$	$2{,}63\pm0{,}51^{a}$
Heart	**Male**	$0{,}59\pm0{,}54^{a}$	$0{,}92\pm0{,}05^{a}$	$0{,}84\pm0{,}27^{a}$	$0{,}81\pm0{,}17^{a}$
	Female	$0{,}83\pm0{,}04^{a}$	$0{,}81\pm0{,}09^{a}$	$078\pm0{,}39^{a}$	$1{,}05\pm0{,}20^{a}$
	Mean	$0{,}84\pm0{,}48^{a}$	$0{,}87\pm0{,}08^{a}$	$0{,}80\pm0{,}04^{a}$	$0{,}86\pm0{,}12^{a}$
Gizzard	**Male**	$2{,}81\pm0{,}66^{a}$	$2{,}82\pm0{,}13^{ab}$	$3{,}83\pm1{,}09^{b}$	$3{,}65\pm1{,}40^{ab}$
	Female	$2{,}94\pm0{,}88^{a}$	$3{,}40\pm1{,}43^{ab}$	$4{,}59\pm0{,}23^{b}$	$3{,}90\pm1{,}30^{ab}$
	Mean	$2{,}87\pm0{,}70^{a}$	$3{,}11\pm0{,}96^{ab}$	$4{,}21\pm0{,}82^{b}$	$3{,}77\pm1{,}21^{ab}$
Abdominal fat	**Male**	$0{,}67\pm0{,}40^{a}$	$0{,}46\pm0{,}10^{a}$	$1{,}04\pm0{,}48^{a}$	$0{,}65\pm0{,}35^{a}$
	Female	$1{,}96\pm1{,}34^{a}$	$0{,}90\pm0{,}53^{a}$	$1{,}21\pm0{,}42^{a}$	$1{,}05\pm0{,}38^{a}$
	Mean	$1{,}31\pm1{,}10^{a}$	$0{,}68\pm0{,}41^{a}$	$1{,}12\pm0{,}41^{a}$	$0{,}84\pm0{,}39^{a}$
Gonado somatic index	**Male**	$1{,}84\pm0{,}34^{ab}$	$1{,}26\pm0{,}39^{a}$	$2{,}27\pm0{,}34^{b}$	$2{,}50\pm0{,}36^{b}$
	Female	$1{,}04\pm0{,}71^{a}$	$1{,}10\pm0{,}85^{a}$	$2{,}18\pm1{,}51^{a}$	$0{,}40\pm0{,}27^{a}$

a, b: on the same column and for the same gender, the assigned values of the same letter are not significantly different (P>0,05)

DISCUSSIONS

The relative higher weekly total FI were obtained with T3 treatment compared to the control. These results are close to those of Paguia et al. (2014) who found that feed intake with levels of 0.20%, 0.40%, 0.60% and 0.80% supplementation of the diet by MOLM in laying hens was significantly higher than the FI of the control batches. This increase in consumption could be explained by some palatability of MOLM in these birds because of its richness in vitamins and nutrients (Paguia et al., 2014).

Overall, body weight has increased significantly with the supplementation level of MOLM in feed. at the end of the trial, T2 treatment induced high weights and the highest average weight gain regardless of the sex. These results are similar to those of Vali (2009) who obtained at 63 days, a live weight of 221.92 g but are higher than those of Bonos (2010), Abdel-Azeem and Abdel-Azeem (2010) who recorded at 6 weeks, weights of 172 g and 199 g respectively. This variability of the weight could be explained either by the age or by the orientation of some lines towards a precocity in the meat production (Cambell et al., 2003; Vali, 2009). The improvement in live weight and weight gain in our study with T2 treatment would mean a better assimilation of nutrients due to a level of supplementation of *MOLM* which seem to be optimal for the finishing period (Kakengi et al., 2003).

FCR increased overall over time. The high values of weekly FCR recorded during the last few weeks of growth, especially could be justified by the high feed consumption coupled with the low weight gains for the same period the highlighting the decrease in the bird's ability to convert the food at the end of growth periods (INRA 1989; Berrama et al., 2011).

Treatments T1 and T2 presented the highest whole carcass proportion compared to the control and could be due to an optimal level of MOLM in the diet. David et al. (2012) found that MOLM improves carcass yields at slaughter compared to the control in broilers, which is also the case in our trial for the whole carcass and not for the standard. This increase in whole carcass yield could be due to the fact that *MOLM* is concentrated in nutrients in the raw form that also appears to reduce the activity of pathogenic bacteria and improves the digestibility of food, thus helping poultry to express its genetic potentials. Indeed, replacement of antibiotic growth promoters with MOLM by 0.1% has been beneficial on carcass growth and carcass yield of broilers David et al. (2012).

Regardless of gender, the significantly higher chest proportions were induced with T2 treatment. This result is contrary to the observations of Corrêa et al. (2008) who reported that the proportion of the chest increased significantly with the level of protein in the ration in female quail. Our results, however, corroborate those of Seyed-Alireza et al. (2011) who found by feeding Japanese quail with diet whose energy-protein ratio ranged from 107 to 138, significant effects on the proportions of the chest.

As with heart and abdominal fat, the proportions of the different batches were comparable to the control group, with slight increases with the supplementation level of MOLM. Similar trends were obtained by Bonos et al., 2010, although lower levels (1.66 to 1.99%), were recorded in Western highland of Cameroon by Djitie et al. (2015) and could then be explained either by the treatments and/or the environmental conditions amongst others. The T2 treatment induced the relative weight of the gizzards significantly higher compared to the control group, which is contrary to the relative weight of gizzard of *Coturnix japonica* at 07 weeks of age according to Attia et al. (2013). This result could be explained by the hyperactivity of the gizzard which is the crusher muscle of the digestive tract then lead to his development. However, Ologhobo et al. (2014) observed in their study that the relative weight of the gizzard decreased significantly by increasing the supplementation levels of the *MOLM* feed compared with control lots, which is not the trend obtained in our work. In addition, a difference between the ratio of gizzard/live weight was observed in favor of females in the control group compared with males. It may be related to increased consumption of the feed by females in preparation for oviposition (Sauveur, 1988). The significantly higher gonado somatic index recorded in male with T2 and T3 could be lead to a good development of testis and a precocity in the sexual maturity.

CONCLUSIONS

Diet supplemented with 2% powdered of *Moringa oleifera* leaves induced a significant increase in live weight and average weekly weight gain.

In general, diet supplemented with *M. oleifera* leaves meals significantly improved whole carcass yield, chest, neck and gizzard relative weight. T2 treatment is therefore the most appropriate for quail in the growth phase;

3% supplementation of diet with MOLM induced in males an increase in testicular weight and gonado-somatic index and in females a precocity at the entrance to reproduction and a high rate of spawning and can therefore be used in the reproduction phase.

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