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Chemical Composition and Zootechnical Effects of Essebtial Oil of Fennel (*Foeniculum Vulgare* Mill.) and Anise (*Pimpinella Anisum* L.) on Turkey

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ABSTRACT

The main aim of this study was to investigate the effects of the dietary oils from fennel and anise on the zootechnical performances of Turkey. The essential oils were analyzed by gas chromatography coupled to mass spectrometry. One Hundred turkey males meat strain BUT 10 (*Meleagris gallopavo*), of one day old, were weighed and randomly allotted into 5 groups of 20 turkeys each. These groups were fed, for 35 days, the basal diet (Control) or the basal diet supplemented with 0.2 g/kg of fennel oil (EOFVD1), 0.5 g/kg of fennel oil (EOFVD2), 0.2 g/kg of anise oil (EOPAD1) and 0.5 g/kg of anise oil (EOPAD2). The mean body weight of EOFVD2 group (807.85 g) was higher than other groups at the end of the treatment ($P<0.05$). Likewise, mean body weight of the EOPAD1 group (782.45 g) was different from those of EOFVD1 (769.89 g), EOPAD2 (756.77 g) and Control group (768.35 g) ($P<0.01$). The results related to the average day weight gain (ADG) indicated that subjects belonging to the batches treated with EOFVD2, EOPAD1 and EOFVD1, expressed the best performance with ADG respective of 79.46±4.03 g/d, 51.12±27.88 g/d, 50.47±26.94 g/d, followed by control group (49.76±26.67 g/d), against 49.98 ±28.46 g/d for the EOPAD2 group with a difference which is statistically significant ($P<0.05$). These results concluded that supplementing diets with essential oils of fennel and anise, which improved body weight, could be interesting feed additives for growth promotion turkey.

Key words: Essential Oil, Zootechnical Performance, Anise, Fennel, Turkey, Medicinal Plants.

INTRODUCTION

In order to control the level of health and to ensure the quality and productivity in livestock animals, veterinary and farmers use diet supplemented with antibiotic and/or hormones. The purpose of these agents aims to keep the animals healthy and lead to their welfare. In our days, antibiotics are widely prescribed in animals, both as therapeutic and prophylactic. They are indispensable tools in the farms in intensive production (Dehaumont et al., 2005). However, the use of those chemical products may cause unfavorable side effects (Asakura et al., 2001). Moreover, there is evidence indicating that these products could be considered as pollutants for human and menace the health on the long-run (Weiss et al., 2007). Tries to utilize the natural materials such as medicinal plants could be widely accepted as feed additives to improve the efficiency of feed utilization and productive performance (Aboul-Fotouh et al., 1999). Thus, several approaches have been explored to flush substitute products with health and zootechnical properties. If several bioactive products are competing for the succession, aromatic and medicinal plants and essential oils seem best recommended (Wina et al., 2006). Sweet fennel (*Foeniculum vulgare* Mill.) is an estrogen (Albert-Puleo et al., 1980; Malini et al., 1985; Annusuya et al., 1988), antioxidant and immune booster's useful in dyspepsia. It has also bronchodilatory effects (Boskabady et al., 2004). It revealed the immunomodulatory effect of NFkappaB activities that plays critical roles in apoptosis and immunomodulation (Kaileh et al., 2007). In other hand, anise (*Pimpinella anisum* L.) has been studied for its

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antiparasitic and digestion, stimulating properties (Cabuk et al., 2003), as well as its antibacterial (Tabanca et al., 2003), antimicrobial (Al-Kassie, 2008), antifungal (Soliman et al., 2002), antioxidant (Gulcin et al., 2003), anthelmintic (Bhatti et al., 1996), antipyretic (Afifi et al; 1994), and hypocholesterolemic activities. Additionally, anise is reported to possess anticonvulsant (Pourgholam et al., 1999), antiepileptic (Janahmadi et al., 2008) and muscle relaxant (Albuquerque et al., 1995) attributes.

This study was borne out to investigate the zootechnical performances of Turkey submitted to diets containing essential oils of fennel (*Foeniculum vulgare* Mill.) and anise (*Pimpinella anisum* L.), as growth promoters.

MATERIAL AND METHODS

Animals and dietary treatments

This study was conducted within the educational poultry station of the Royal Institute of Specialized Technicians in breeding Fouarat/Kenitra (Morocco). One Hundred turkey males meat strain BUT 10 (*Meleagris gallopavo*), of a day old, were weighed and randomly allotted into 5 groups of 20 invidious each. These groups were fed, for 35 days with commercial feed (Table 1), the basal diet (Control) the basal diet supplemented with 0.2 g/kg of fennel oil (EOFVD1), 0.5 g/kg of fennel oil (EOFVD2), 0.2 g/kg of anise oil (EOPAD1) and 0.5 g/kg of anise oil (EOPAD2) (see Table 2).

Table 1. Nutritional composition of Turkey feed during 25 days of experimental period

Ingredients	Periods	
	Starting food [1 to 25 days]	**Growth food [26 to 35 days]**
Crude protein	31%	27%
Fat	9%	10%
Metabolizable Energy (Kcal/kg)	2900 Kcal/Kg	3000 Kcal/Kg
Cellulose	4%	4.9%
Minerals		
Calcium	1.5%	1.5%
Phosphate	1.1%	0.88%
Salt	0.2%	0.2%
Other Minerals	7.6%	7%
Vitamins		
A	2000000 IU	1800000 IU
D3	500000 IU	400000 IU
E	4000 IU	3000 IU
Treatments		
Fennel	0.5 and 0.2 g/l	0.5 and 0.2 g/l
Anise	0.5 and 0.2 g/l	0.5 and 0.2 g/l

Table 2. Distribution of experimental groups of turkeys during 35 days of experimental period

Treatments	Group 1 Control	Group 2 EOFVD1 (g/Kg)	Group 3 EOFVD2 (g/Kg)	Group 4 EOPAD1 (g/Kg)	Group 5 EOPAD2 (g/Kg)
Start-up 1-25 day	Food Starting	Food Starting + 0.2	Food Starting + 0.5	Food Starting + 0.2	Food Starting + 0.5
Growth 26-35 day	Food growth	Food growth + 0.2	Food growth+ 0.5	Food growth + 0.2	Food growth + 0.5

Abbreviations: EOFVD1: 0.2 g/kg of Essential Oil of Fennel; EOFVD2: 0.5 g/kg of Essential Oil of Fennel; EOPAD1: 0.2 g/kg of Essential Oil of Anise; EOPAD2: 0.5 g/kg of Essential Oil of Anise

Extraction of essential oil

Seeds of fennel and anise were dried at room temperature. One hundred grams of dried seeds of each plant were submitted to the hydrodistillation for 3 h using a Clevenger apparatus (European Pharmacopoeia, 2004). Essential oils immiscible with water are directly recovered using a micropipette without adding solvent and then stored in dark bottles at 4°C.

GC-MS Analysis

The essential oils were analyzed by gas chromatography coupled to mass spectrometry (GC-MS) **(**Sandra and Bicchi, 1987; Adams, 1995; Sajjadi and Khatamsaz, 2003; Yadav and Agarwala, 2011) using the Thermo Fisher apparatus. It consisted of chromatograph Trace GC Ultra type coupled to a mass spectrometer Polaris Q type. The capillary column used is a DB5 30 m long, 0.25 mm diameter and 0.25 µm thick. The oven temperature was programmed at 60°C for 5 minutes and gradually rose up to 300°C at the 2°C/min for the remaining 10 minutes. The carrier gas used was helium with a flow rate of 1 ml/min. The sample was injected with a volume of 1 µl. Mass spectra of different compounds identified are

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recognized and affirmed by using the database of mass spectra of pure products (NIST: National Institute of Standards and Technology, USA).

Performance Parameters

Evaluation of growth performance of turkeys of various flooring was made by daily and weekly weighing. Those values allow calculating the following output parameters: mean body weight, total body weight, average daily gain and cumulative weight.

Statistical Analysis

The ANOVA test was performed to compare the crude parameters. The analyses reported in this study were performed using the Statistical Analysis System (SAS). P values less than 0.05 were considered statistically significant.

RESULTS AND DISCUSSION

Chemical composition of the essential oil of fennel and anise seeds

Analysis of essential oils of fennel and anis, by GC/MS, has permitted us to achieve the chromatograms shown in figures 1 and 2. The whole of the compounds was subjected to identification by mass spectrometry (Table 3 and 4).

Table 3. Chemical composition of essential oil from *Foeniculum vulgare* Mill. Seeds.

Compounds	Retention Time (min)	%
α-pinene	5,64	0,38
Camphene	6,29	0,13
β-pinene	7,25	0,06
delta-3-carene	7,45	0,04
α-terpinene	7,99	0,11
p-cymene	9,83	0,13
Limonene	9,97	2,37
1,8-cineol	10,14	0,23
Trans-β-ocimene	10,40	0,12
Fenchone	13,51	3,40
Camphor	17,17	0,24
Eustragole	20,63	5,20
Fenchyl acetate	22,35	0,12
Carvone	23,71	1,03
Cis-anethole	24,26	0,16
Anisaldehyde	24,79	4,09
Trans anethole	26,75	78,37
Myristicin	41,23	0,07
Apiol	46,77	3,72
Total	-	99,97

Table 4. Chemical composition of essential oil from *Pimpenella Anisum L.* seeds.

Compounds	Retention Time (min)	%
α-pinene	5,64	0,08
Camphene	6,30	0,02
delta-3-carene	7,45	0,02
α-terpinene	7,98	0,01
p-cymene	9,83	0,03
Limonene	9,98	0,05
1,8-cineol	10,13	0,16
α-terpinene	11,59	0,03
Fenchone	13,50	0,04
Terpinolene	14,19	0,16
Camphor	17,16	0,08
Eustragole	20,62	1,22
Carvone	23,75	0,06
Cis-anethole	24,26	0,25
Anisaldehyde	24,94	0,89
Trans anethole	27,09	82,69
Bicyclogermacrene	28,87	0,08
Cadinène	37,78	2,80
Germacrene D	37,97	0,39
Cuparene	38,23	0,31
Trans-β-bergamotene	39,07	0,55
Methyl eugenol	39,47	0,30
Pseudoisoeugenyl-2-methyl butyrate	58,33	6,68
Epoxy pseudoisoeugenyl 2-methyl butyrate	60,93	1,31
Total	-	98,21

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Analysis of essential oil of *F. vulgare* Mill seeds shows the presence of trans-anethole as major compound, followed by estragole, anisaldehyde, apiol and fenchone to the respective levels of 78.37%, 5.2%, 4.09%, 3.72% and 3.4%. While analysis of essential oil of anise seeds revealed that the predominant compounds were to that in fennel, with a slight difference in concentrations (trans-anetole 82.69%, Pseudoisoeugenyl-2-methyl butyrate 6.68%, cadinene 2.8% and estragole 1.22%).

Average live weight

The evolution of average live weight (all ages combined) put down in 35 days is shown in figure 3.

The average live weight recorded during the rearing period (D1-D35) shows that subjects belonging to the birds treated with EOFVD2 (dose = 0.5 g/kg of fennel essential oil) and EOPAD1 (dose = 0.2 g/kg of anise essential oil) expressed the best performance with respective weight of 807.85 g/d and 782.45 g/d, compared to control group 768.35 g/d with a variation respectively of +5% and +2% of contribution to the control group. Average live weight declined the most observed in the birds treated with 0.5 g/kg of anise oil (EOPA2) and EOFVD1 (0.2 g/kg of fennel essential oil) with respective values of 756.77 and 769.89 g/d, respectively, compared to the control group (768.35 g/kg). Those observations were consistent with those of Tollba et al. (2003), who has noted that the addition of fennel has resulted in improved growth. For anise, Al-Beitawi et al. (2009) found that the addition of 200 ppm of the essential oil of Anise and Oregano increased body weight and feed conversion by contribution to the control. The observations of this study are consistent with the conclusion of Ertas et al. (2005) who reported that the addition of 200 mg/l of essential oil mix derived from origano, clove and anise to the poultry feed resulted in a growth-enhancing. In contrast, the addition of 400 mg/l of this oil led to a significant decrease in body weight by contributing to the control. This reduction in body weight can be excused by the negative outcome of high dose (400 mg/kg) on the digestive system.

Landy et al. (2011) reported that the addition of high doses of medicinal plants in the diet might induce a negative consequence on some beneficial microbial population as Lactobacillus.

Average Daily Gain

The average daily weight gain (ADG) reported in different Turkey groups is shown in figure 4. The best ADG is observed in group EOFVD2 with a value of 79.46 ± 74.03 g/d, followed by EOPAD1 (51.12 ± 27.88 g/d) of EOFVD1 (50.47 ± 26.94 g/d) and EOPA2 (49.98 ± 28.46 g/d); with a difference of +59%, +3%, +2% and 0.6% respectively, which is a significant increase ($p<0.05$) compared to control group (49.76±26.67 g/d). From these results it is found that the group treated by EOFVD2 and EOPAD1 expressed the best performance with respective ADG of 79.46 ± 74.03 g/d and 51.12 ± 27.88 g/d compare to 49.76 ± 26.6 g/d for the control group, a respective variation compared to the control group of + 59%, 3% compared to the control group that exceeds that allowed by antibiotics which is the range of 3% to 7% (Coates et al., 1977).

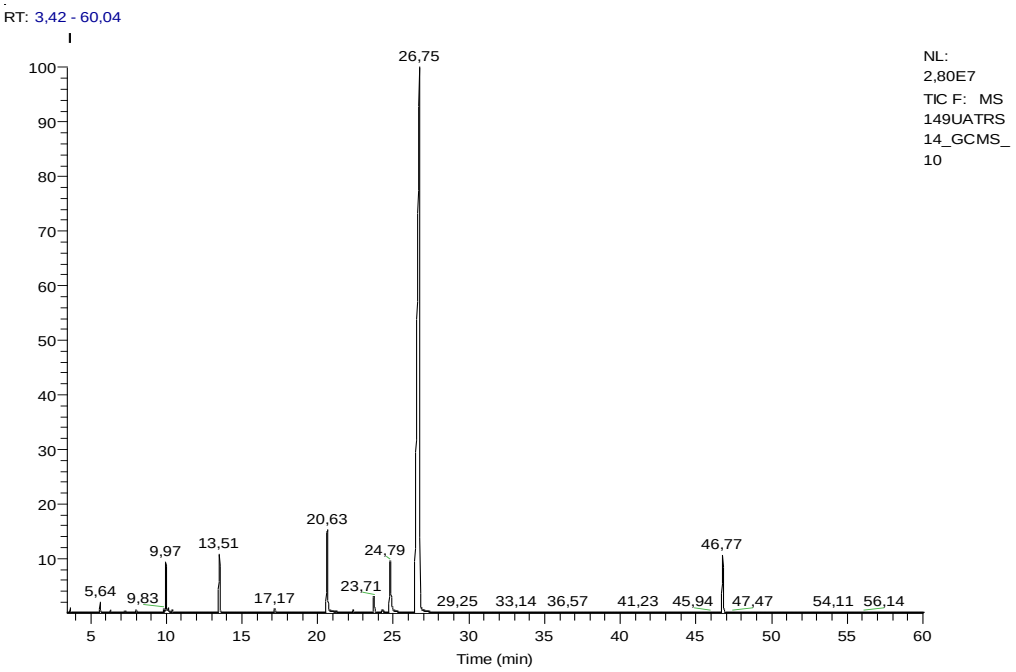

Figure 1. Chromatogram of the essential oil of *Foeniculum vulgare* Mill.

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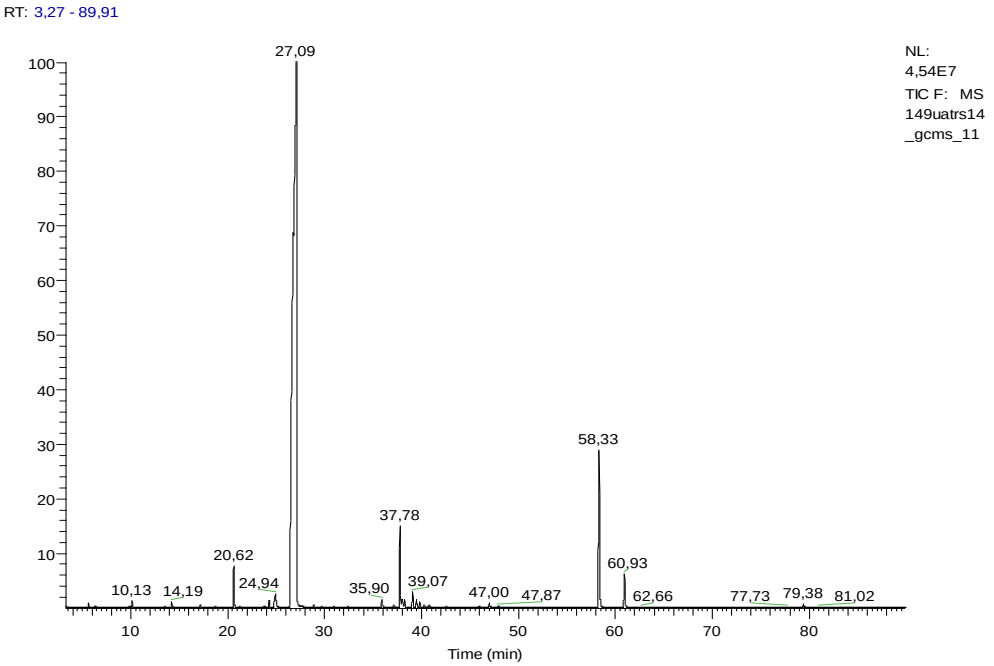

Figure 2. Chromatogram of essential oil of *Pimpenella Anisum L*. seeds.

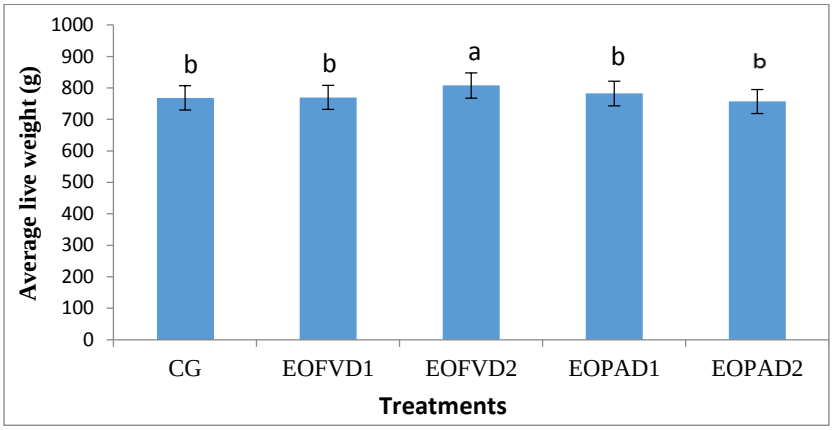

Figure 3. Comparison of the average live weight in turkeys fed with basal diet supplemented with essential oil of Fennel and Anise. (Abbreviations: EOFVD1: 0.2 g/kg of Essential Oil of Fennel; EOFVD2: 0.5 g/kg of Essential Oil of Fennel; EOPAD1: 0.2 g/kg of Essential Oil of Anise; EOPAD2: 0.5 g/kg of Essential Oil of Anise; CG: Control Group. Average (ab): The different letters show a significant difference at the 5% level).

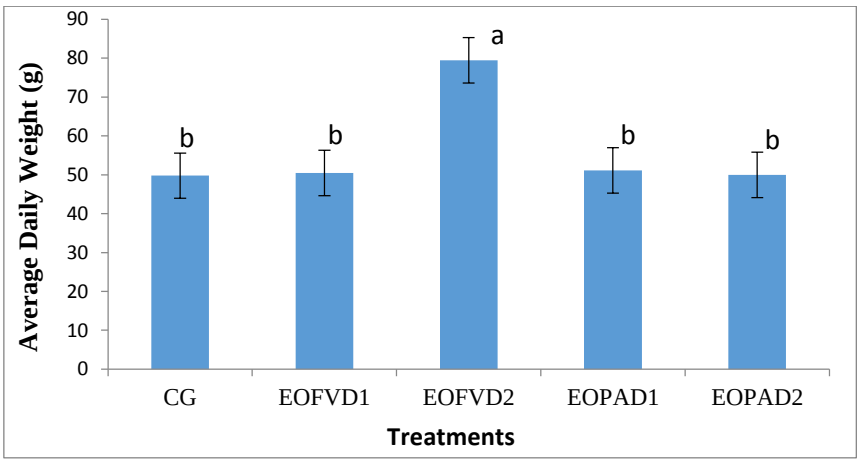

Figure 4. Comparison of average daily weight gain in turkeys fed with basal diet supplemented with essential oil of Fennel and Anise. (Abbreviations: EOFVD1: 0.2 g/kg of Essential Oil of Fennel; EOFVD2: 0.5 g/kg of Essential Oil of Fennel; EOPAD1: 0.2 g/kg of Essential Oil of Anise; EOPAD2: 0.5 g/kg of Essential Oil of Anise; CG: Control Group. Average (ab): The different letters show a significant difference at the 5% level).

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This improvement may be due to the most appetizing and digestive stimulant effect of some active components (such as anethole, thymol and eugenol) in these essential oils, which also have antimicrobial activity and they improve weight gain (Valero et al., 2003; Cabuk et al., Tabanca et al., 2003; Ph.Eur, 2005). Furthermore, El-Deek et al., (2003) reported that fennel stimulates the flow of digestive juices in the stomach and intestine and increase the efficiency of broken fat into fatty acids. The weekly live weight evolution described for each group is presented in Table 5. We establish that there were no significant differences in mean body weight between birds up to 21 days. From fourth week, the evolution of body weight between different birds has become accentuated with a remarkable trend in favor of the treatment groups with EOFD2 and EOAD1.The comparison of the means showed that the highest average live weight was calculated for the group EOFD2 (1922.5 ± 137.14 g) ($P<0.05$), while the other doses showed no significant difference by contributing to the control group.

Table 5. Evolution weekly body weight (g) of Turkeys during 35 days of experimental period

Parameters	D1	D7	D14	D21	D28	D35
Control group	84.13 ± 6.88	221 ±17.74	4465 ± 4283	793.5 ± 46.59	1232.5 ± 102.8	1832.5 ± 105.47
EOFVD1	79.84 ± 4.42	229.7 ± 29.22	443.5 ± 34.79	763.2 ± 71.75	1255.5 ± 125.59	1847.5 ± 128.22
EOFVD2	82.62 ± 3.98	231 ± 19.79	465 ± 37.76	828.5 ± 62.59	1317.5 ± 111.53	1922.5 ± 137.14
EOPAD1	80.74 ± 8.33	219.5± 21.14	444.5 ± 44.54	800 ±73.48	1280 ± 103.1	1870 ± 112.85
EOPAD2	80.64 ± 9.5	221.5 ± 23.00	436.5 ± 40.68	764.5 ± 75.42	1207.5 ± 111.53	1830 ±103.1
SEM	0.7	2.26	4.05	6.98	11.59	12.06
P Value	0.87**	0.156**	0.127**	0.116**	0.063**	0.046*

Abbreviations: EOFVD1: 0.2 g/kg of Essential Oil of Fennel; EOFVD2: 0.5 g/kg of Essential Oil of Fennel; EOPAD1: 0.2 g/kg of Essential Oil of Anise; EOPAD2: 0.5 g/kg of Essential Oil of Anise; SEM: standard error of the mean. NS: Non significative, *P< 0.05, **P< 0.01.

CONCLUSION

The subjects belonging to the birds treated with 0.5 g/kg of the Essential Oil of fennel (EOFVD2), expressed the best live weight (1922.5 g) with significant differences ($P<0.05$) compared to other groups, followed by EOPAD1 (1870 g), the OEFVD1 (1847 g), witness (1832.5 g) and EOPAD2 (1830 g). The subjects belonging to the turkeys supplemented by EOFVD2 and EOPAD1 recorded the best average daily gain compared to the control group, with respective values of 79.46 g, 51.12 and 49.7 g, that are statistically significant ($P<0.05$).

The results of our study showed that supplementation with essential oil of fennel and anise could be interesting feed additives in improving the zootechnical performance of turkey.

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