EFFECT OF LINSEED SUPPLEMENTED INTODUCTION PERIOD AND DURATION IN BROILER's DIET ON THEIR ZOOTECHNICAL PERFORMANCES, NUTRITIONAL CHARACTERISTICS AND MEAT QUALITY

H. Nasri[1], C. Damergi[1], M. Bouzouia[2] and H. Boukhris [1]

[1] National Agriculture Institute of Tunis TUNISIA

[2] National Veterinary School, Sidi Thabet TUNISIA

Abstract – 5292 Arbor Acres chicks distributed over 6 treatments (T) received feed enriched with linseed during different periods: T35 (d1 to d38), T28 (d7 to d35), T21 (d14 to d35), T14 (d21 to d35), T7 (d28 to d35) and T0 (control). During 35 breeding's days, weekly measurements were performed on zootechnical performances. After slaughter, rate's analysis of UFA, MUFA, PUFA and oméga3, then sensory analysis was performed in the breast and thigh. Statistical analysis gave these results: weight and mortality rate improved with treatment's period higher than 14days. The higher rate of omega3 was achieved with treatments T21 and T28 with 5.9% rate. The highest quantities of UFA (unsaturated fatty acid), MUFA (monounsaturated fatty acid) and PUFA (polyunsaturated fatty acid) were achieved with treatments T28. T21, T28 and T35 gave amounts of omega3 higher than 3mg/100g. Sensory qualities were improved with treatments T28 and T21.

Key Words – Linseed, Sensory analysis, Zootechnical performances

I. INTRODUCTION

Omega3 in our diet can influence positively a variety of physiological functions (like brain development, inflammation, platelet aggregation) and prevent many diseases, including cardiovascular disease, disease of Alzheimer, rheumatoid arthritis. This PUFA cannot be synthesized by the human organism but it can be supplied through the diet [1]. The incorporation of linolenic acid in broilers' diet improves zootechnical performances as well as fatty acid composition and sensory quality of meat [2]. The contribution of extruded linseed, which is rich in omega3, in broilers' diets tend to reduce the rate of UFA [3] and to increase the amount of PUFA and omega3 in their meat [4, 5]. Products respecting a certain protocol on the sources and incorporation's rate of omega 3 are significantly preferred to standard products and have achieved best marks color, taste, odor, tenderness and juiciness [7]. This study aims to optimize a food program for obtaining a meat source of omega3 according to European Union legislation, which determines this designation by the existence of an oméga3 rate equal at least to 0,3g per 100 g of meat, by the determination of the optimal age of distribution of diet enriched in omega3. We will evaluate also the effects of the duration of linseed's incorporation at different stages of broilers' growth on zootechnical performance, then on nutritional characteristics and the quality of meat.

II. MATERIALS AND METHODS

For this trial 5292 one day old Arbor Acre chicks was divided into 6 treatments, one control and others received for 35 days a standard diet or a diet enriched with 0.975% omega3 derived from extruded linseed according to table 1. The two diets are isolipidic, isoprotic and isoenergetic.

Table 1 Experimental dietary calendar

Treatment	T35	Control diet + linseed			
	T28	Control diet	Control diet + linseed		
	T21	Control diet	Control diet + linseed		
	T14	Control diet	Control diet + linseed		
	T7	Control diet	Control diet+ linseed		
	T0	Control diet			
	Diet	CF1Crumbled	CF1 Granulated	CF2 Granulated	
	Rearing phase	Startup	Growing	Finish	
	Age(days)	7 14	21 28	35	

During rearing period, weekly measurements were done on weight, ADG (average daily gain) and FC (feed conversion). After slaughtering biochemical analyzes concerning composition on UFA, MUFA, PUFA and omega3 of the sternum and thigh were performed.

From each repetition 3 thighs and 3 sternums were collected, we had 18 sternums and 18 thighs from each treatment. Each group composed of 9 thighs coming from the same treatment and different repetitions are mixed to give one sample. So we got 2 thigh's samples from each treatment. Similarly, we obtained 2 sternum's samples from each treatment. We also conducted a sensory analysis of color, odor, juiciness, tenderness and fibrousness of sternum and thigh from different treatments. The tasting panel was composed of 30 trained tasters. The meat was cooked in electronic ovens at 200°C heating homogeneously for 20 minutes. The tasting took place in isolated cabinets in absence of external interference factors. Results underwent statistical analysis using the GLM procedure (General Linear Model) multi-variable SAS software. The significance level adopted was 5%.

III. RESULTS AND DISCUSSION

Zootechnical performances:

The linseed attribution's age on broilers' diet increased significantly the weight, $ADG_{d35\text{-}d0}$, and FC and reduced significantly the mortality rate. The highest weights were obtained with treatments T7 and T35 with respective difference of 138.77g and 138.44g compared with T0. The best $ADG_{d35\text{-}T0}$ was obtained with treatments T28 and T21 with respective averages of 53.25g and 52.06g and the lowest one with treatments T7 and T0 with respective averages of 48.32g and 49.54g. The lowest mortality rate was there of treatments T35, T28 and T21 with respective averages of 5.29%, 6.22% and 6.22% against 96.56% for treatment T0. The highest FC was these of treatments T35, T14, T21 and T28 with respective average of 1.75, 1.75, 1.85 and 2.15 against 1.59 for T0.

The treatment's period had also a significant effect on different zootechnical parameters. We note that the weight and the $ADG_{d35\text{-}d0}$ increased significantly after a treatment period of 21, 28 and 35days. Weights' differences were 78.35g, 70.83g and 110.69g and $ADG_{d35\text{-}d0}$ differences were 5,69g, 4,6g and 8,16g respectively between 21, 28 and 35 days of treatment period and T0. The highest weights and ADGd35-d0 were obtained with the highest processing times. Lowest mortality rate was obtained with treatment duration of 28, 35 and 21days. The lowest FC was obtained with a treatment's period of 0 and 7days and the highest one with 28days with a difference of 0.69 and 0.67 respectively between 28days of treatment and T0 and between 28 and 7days of treatment.

If we consider age as a variation's factor we noted that the weight and mortality decreased if linseed's introduction in broilers' diet occurred between the 7^{th} and 14^{th} days of age, ADG improved if this introduction happened before 21days of age and F.C increased after linseed's introduction in the diet whatever the age of introduction was. If we consider treatment's duration as a variation's factor, we note that it had a significant impact on zootechnical performance. In fact, the weight increased and the mortality rate decreased after 14days of treatment, the ADG improved after a treatment's period greater than or equal to 14days and the highest F.C was obtained with 28days of treatment. The literature revealed that if chickens were fed a diet enriched with linseed their weight increased by 15.16 g and their ADG increased by 2,37g compared to the control [3]. The effect of linseed's addition in broilers' diet on weight and ADG was significantly perceptible only after two treatment's weeks [8].

Fatty acid composition:

The rates of UFA and PUFA were higher in trial treatment meat. The highest UFA's rates was obtained with treatments T21 and T28 with respective values of 69.21% and 69.03% and those of PUFA with treatments T14 and T28 with respective values of 24.13% and 24.09 %. The lowest UFA's and PUFA's rates were those

of T0 with respective averages of 68.46% and 22.70%. MUFA's rate decreased with linseed's incorporation. Concerning muscle, the highest rates of UFA, MUFA and PUFA were obtained in the breast meat with respective differences of 0.63%, 0.06% and 0.60% compared to the thigh muscle. The rate of omega3 increased significantly after linseed's incorporation. The highest rates were obtained with treatments T14, T21 and T28 with respective averages of 5.97%, 5.95% and 5.26% and the lowest one with T0 with an average of 2.67%. No significant muscle's effect on the rate of omega3 had been recorded. However, we noted that the highest rate was obtained in breast meat with a difference of 0.22% compared to the thigh meat.
The amounts of UFA, MUFA and PUFA in thigh muscle had two different behaviors: with treatments T7 and T14 they decreased to an amount less than that of T0 with respective averages of 3.40 and 3.52 mg/100g for UFA, 2.21 and 2.30mg/100g for MUFA, 1.19 and 1.22mg/100g for PUFA. From T21 they began to increase, reaching with T28 and T35 levels higher than T0 with respective averages of 5.05 and 5.02mg/100g for UFA, 3.35 and 3.34mg/100g for PUFA, 1.71 and 1.68mg/100g for PUFA. Quantities of omega3 in thigh meat of treatments T35, T28 and T21 had significantly exceeded that of T0. The highest amounts were obtained with treatments T28 and T21 with respective averages of 0.44 and 0.30mg/100g. While treatments T0 and T14 gave the lowest amounts with respective averages of 0.16 and 0.23mg/100g.

The best UFA rate was obtained with treatment T21. It is noting an UFA rate of 70.80% and 72.20% respectively with broilers receiving diet fortified with 7.5% and 15% of linseed against 68.47% with control treatment [9].

MUFA rate decreased with linseed's incorporation into the diet except the treatment lasting 35days for which MUFA rate increased slightly, the PUFA rate varied only by 0,5% between treatments T7, T14, T21 and T28. The highest amounts of UFA, MUFA and PUFA were obtained with treatments T28 and T35. It is mentioned in literature the same behavior evolution of the MUFA and PUFA quantity in thigh meat. The MUFA quantity decreased after distribution diet enriched with linseed. It rose from 1.83 to 1.63 mg/100g between a treatment's periods of 4 to 16days, and then from a period ranging from 20 to 35days it increased to 2.49 mg/100g, while the PUFA rate increased from 1.80 to 2.01 mg/100g for respective period of 20 and 35days of treatment [1]. The highest rates of UFA, MUFA and PUFA were obtained in breast meat. This result is on agreement with the bibliography in which it is mentioned a minimum level of UFA, MUFA and PUFA of 62.5%, 35.3% and 27.2% in breast meat [10], against a minimum rate of UFA, MUFA and PUFA of 66.10%, 38.07% [11] and 27.10% [12] respectively in thigh meat.
The best omega3 rates were those obtained with treatments T21 and T28 with equal rates. The rate of omega3 was higher in breast meat than in thigh meat with a difference of 0.22%. The bibliography noted that lipids of the breast meat contained more omega3 than thigh meat [13]. The quantity of omega3 in thigh meat increased with the increase of the duration of distribution of diet enriched with linseed. Treatments T21, T28 and T35 gave omega3 amounts higher than 3mg/100g which is the amount necessary to obtain a meat rich in omega3. It is noted in literature an increase in the omega3 amount in thigh meat with the increasing of the duration of linseed's introduction on the diet with maximum rates of 0.64 and 0.79 respectively after 20 and 35 days [1].

Sensory evaluation: (Table 2)

In both types of muscles we noted that the color's meat intensity obtained with trial treatments was lower than that in T0 except treatment T35, the tenderness intensity increased in two muscles except breast meat of T35 and thigh meat of T7. The flavor intensity was the best in thigh meat while in breast meat it was quasi constant for different treatment's durations except treatment T21 for which the intensity decreased compared to T0. The smell intensity in breast meat decreased significantly in treatments T14, T21, T28 and T35 compared to T0, while in thigh meat smell's intensity of treated groups was almost constant except the treatment T7 which presented a remarkably

higher intensity than other treatments. Juiciness in breast meat decreased in trial treatments except T28 in which juiciness increased. In thigh meat juiciness increased with trial treatments but this increase wasn't proportional to the treatment's duration; it was at its maximum with treatment duration of 7 days. Linseed's introduction in broilers' diet had no significant effect on meat fibrousness in the breast or thigh except the difference between treatments T14 and T28 in breast meat. The intensity of color, tenderness, flavor, odor and juiciness in thigh meat was higher than it in the breast while fibrousness was lower in thigh meat.

In the breast meat the lightest color and the lowest smell were obtained with 21days treatment duration, whereas with the thigh meat it was obtained with treatment periods of 14, 28 and 21days. The most pronounced flavor in breast meat was obtained with the control treatment and 28days treatment duration, while in thigh meat it was obtained with treatment durations of 28 and 21days. There is noted in bibliography that the linseed's addition in broilers' diet decreased color index from 7.79 to 7.14, to 7.64 and to 7.57 and flavor index from 7.29 to 7.64, 7.36 and 7.29 for diet enriched respectively with 5%, 10% and 15% of linseed [8]. While smell's intensity decrease from 6 to 5.1 and to 5.3 with diet enriched respectively with 3.5% and 7% of a source of omega3 [14]. The juiciest breast's meat was obtained with treatment's duration of 28days, and the juiciest thigh meat with a period of 7 and 14days. We noted that in thigh meat all treatments that received linseed in their diet gave meat juicier than T0. For tenderness, treatment duration of 28, 21days and T0 gave the most tender breast meat and the treatment's duration of 14 and 21days gave the most tender thigh meat. The literature reported that the meat's tenderness note derived from diet enriched with linseed was higher than that of meat from a control diet (4.4 against 3.7) [14]. Concerning fibrousness, treatment duration of 28 and 21 days in the thigh meat gave the less fibrous meat

Table 2 Results of sensory evaluation of meat

	Treatment	T0	T7	T14	T21	T28	T35	MSE
Color	Breast	4,25	4,2	4,24	3,41	4,14	4,74	0,16
	Thigh	6,07	5,73	5,26	5,94	5,43	6,41	0,2
Smell	Breast	5,87	5,72	5,5	4,79	5,12	4,91	0,014
	Thigh	5,94	7,49	6,27	6,47	6,45	6,41	0,2
Flavor	Breast	5,1	4,72	4,95	4,26	5	4,74	0,15
	Thigh	6,38	5,37	6,08	6,55	6,93	6,21	0,2
Juiciness	Breast	4,77	4,08	4,31	4,24	5,24	4,46	0,15
	Thigh	5,91	7,52	6,87	6,08	6,37	6,46	0,18
Tenderness	Breast	5,25	5,18	5	5,2	5,99	4,74	0,15
	Thigh	6,17	5,23	6,56	6,35	6,32	6,22	0,19
Fibrosity	Breast	5,31	5,94	5,94	5,7	4,93	5,61	0,16
	Thigh	4,55	4,23	4,36	3,94	4,9	4,99	0,19

IV. CONCLUSION

The optimal duration of linseed's incorporation in broilers' dietary to ameliorate zootechnical performance of broilers, the rate of omega3, the quantity of omega3 and the sensory quality of meat is 21 days.

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