ENRICHMENT OF FLAXSEED FOR DEVELOPING FUNCTIONAL RABBIT MEAT

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Abstract- Rabbit meat is mostly suggested by dietician due its low calories over other meats. At now a lot of research is being carried out to increase its nutritional benefits that make it functional food by enriching it with polyunsaturated fatty acids, antioxidants and vitamins by incorporating in the diet of rabbits. Our current study was to investigate the dietry responses of flaxseed from 3.5 – 7 %. Bearing in mind that this range of flaxseed will fulfil desire n-3 PUFA content of 8.5% of the total fatty acids that characterizes about 19% of the recommended daily allowance (RDA) for n-3 PUFA.

I. INTRODUCTION

Functional foods are categorized in to two primary classes based on the anticipated effects: those planning to enhance physical roles, and aiming of people to slow up the danger of particular pathologies. Within both instances, it should stay meals, and this must show its results in quantities in general likely to be frenzied within the food (1). The nutritional worth of meat comes with a rising significance one of the factors identifying customer acceptability and meat high quality (2). Within last 50 years, world bunny meat manufacturing have elevated by three fold as much as 2.6 million tons last year. China happens to be the planet's leading maker (seven hundred, thousands tones/year) as well as France 51,400 t/year would be the chief bunny meat suppliers in European countries (3). Even though bunny meat provides outstanding dietary and dietetic attributes, it may be supplementary prepared with biologically active constituents to acquire meat regarded as functional: rabbits feeding along with diets that are supplemented with high polyunsaturated fatty acids or even elongated chains of ω-3 fatty acid material (linseed- entire or even oil, Oat as well as barley and fish essential oil) enrich actual meat along with essential fatty acids, bioactive type of ω-3 fatty acids. Since fatty acid profile of the muscle linearly react to that from the actual feed. Optimum four percent linseed in bunny diet may be viewed as sufficient in order to both accomplish the enrichment associated with ω-3 fatty acid and gaze after good item quality (4). The aim of this study was to explore the potential of dietary use of whole linseed (up to 7%) in fatty acid composition and quality of meat of growing rabbit's.

II. MATERIAL AND METHODS

RABBITS, DIET AND MANAGEMENT

Research was carried out in order to investigate the effect of different inclusion levels of whole linseed (up to 7%) in diets for growing rabbits on their performance and fatty acid composition. A total of forty five rabbits of New Zealand White strains (30±5 days) were purchased from National Institute of Health Islamabad, Pakistan and divided into three groups. Diet was only differed in the amount of whole linseed. Rabbits were fed ad libitum until 8 weeks.

Table 1 Formulation of feed (%)

Ingredients	Feed (T0)	Flaxseed (T1)	Flaxseed (T2)
Alfalfa Fresh	94.0	87.00	90.50
Flaxseed	0.00	7.00	3.50
Calcium-phosphate	1.35	1.35	1.35
Vitamin mineral premixa	1.20	1.20	1.20
Molasses	1.00	1.00	1.00
Salt	0.70	0.70	0.70
Calcium-carbonate	0.70	0.70	0.70
DL-methionine	0.05	0.05	0.05

SLAUGHTERING, SAMPLE COLLECTION AND MEASUREMENTS

At the end of the 8 weeks, the rabbits were slaughtered following the national regulations applied to commercial slaughtering and sampling of loin and hind leg meat was done. Rabbits were slaughtered at the farm by cervical dislocation and then the meat was stored at −4 °C in a refrigerator (Sanyo, Japan) for further analysis. Individual feed consumption (FC) was measured each week for all animals from 30

days of age until 12 weeks of age. Animals were individually weighed on weekly basis. The food conversion ratio (FCR) was estimated between 30 days of age and 12 weeks.

SAMPLE PREPARATION

Five gram meat sample was taken in 50 ml polypropylene tube having a cap and sample homogenized by using phosphate buffer and glycerol (20%) pH (7.4) with the help of homogenizer. The homogenized breast meat sample were centrifuged at 1000 × g for ten minutes to remove the nuclear fraction after that supernatant was collected in a separate tube and then it was used for further analysis.

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FATTY ACIDS PROFILE OF MEAT

The fatty acids content of each sample was determined by running samples through GC (Agilent Technologies 6890 N) using Flame Ionization Detector. Nitrogen gas was used as a carrier with flow rate of 1.3 ml/ min. The fatty acid profile was estimated according to the method described by (5).

STATISTICAL ANALYSIS

The data obtained for each parameter was subjected to statistical analysis to determine the level of significance according to the method described by (6) by using the software package (Statistic 8.1). The Duncan's multiple range (DMR) test was used to estimate the level of significance that existed between the mean values.

III. RESULTS AND DISCUSSION

RABBIT GROWTH PERFORMANCE

Results presented in table 2 showed that enrichment of 7 % flaxseed exert highly significant effect on weight gain of rabbits. T2 that contains 3.5 % flaxseed also showed significant effect. Rabbits that fed on control diet gained minimum weight i.e 2143 gm at the end of 8 weeks trial. T1 fed on 7 % flaxseed showed maximum weight gain i.e 2334 gm at the end of trial. The feed conversion ratio (FCR) of the treatment T1 was 2.94 and the treatment T0 was 3.16. It means that the group containing flaxseed enrichment increased the performance of rabbit's growth as compared to control diet. The results of this study are against the findings of (7) who found poorer weight gain and marginally lesser live weight in broiler chickens fed on a diet containing 15% whole linseed when compared with a control diet. These scientists linked the poorer weight gain to the existence of various poisonous substances in raw whole flaxseed that may reduce energy consumption. More recently (8) reported a lower live weight and decreased growth at slaughter in rabbits fed linseed using diets containing extruded linseed. This evidence was also originated by (9) who observed a decreased (-70g) growth performance of rabbits at slaughter by consuming linseed oil in the diet. However, (10) and (11) did not notice any harmful effect of linseed on productive performances of rabbits. But in our case we used fresh alfalfa meal as a control diet hence these findings are in correlation with the findings of (12) where rabbits fed on alfalfa gained minimum weight as compared to control.

Table 2 Rabbits weight gain on weekly basis in (g/week)

Weeks	w1	w2	w3	w4	w5	w6	w7	w8
T0	593±4.35	803±5.71	1048±6.91	1303±7.11	1538±8.24	1748±9.34	1948±10.01	2143±11.52
T1	609±3.68	844±4.83	1114±5.04	1394±6.21	1654±7.41	1889±8.57	2114±9.73	2334±10.95
T2	604±4.76	826±5.97	1083±6.23	1350±7.39	1597±8.63	1819±9.71	2031±10.81	2238±11.95
Means	602.0^{H}	824.3^{G}	1081.7^{F}	1349.0^{E}	1596.3^{D}	1818.7^{C}	2031.0^{B}	2238.3^{A}

Different superscripts in a row indicate significant difference between the means ($p \leq 0.05$)

Table 3 Feed Conversion Ratio (FCR) of the experimental Rabbits

Weeks	w1	w2	w3	w4	w5	w6	w7	w8	Means
T0	1.71±0.08	2.13±0.01	2.47±0.06	2.98±0.05	3.44±0.03	4.01±0.07	4.17±0.08	4.37±0.08	3.16^{A}
T1	1.62±0.03	2.01±0.03	2.34±0.05	2.80±0.06	3.20±0.05	3.68±0.04	3.82±0.04	3.98±0.09	2.94^{C}
T2	1.67±0.05	2.06±0.04	2.40±0.02	2.88±0.05	3.33±0.02	3.83±0.06	3.99±0.06	4.18±0.05	3.05^{B}
Means	1.67^{H}	2.07^{G}	2.41^{F}	2.89^{E}	3.33^{D}	3.84^{C}	4.00^{B}	4.18^{A}	

Different superscripts in a row indicate significant difference between the means ($p \leq 0.05$)

FATTY ACID COMPOSITION

Rabbit meat fatty acid composition was intensely prejudiced by inclusion of dietary flaxseed. As compared to the general classifications of fatty acids, the flaxseed claimed a lower level of total saturated fatty acids and a higher content of polyunsaturated fatty acids of Loin and leg meat as depicted in table 4 (13). Table 4 showed that enrichment of flaxseed raised the concentration of monounsaturated fatty acids (MUFA). T2 showed higher percentage i.e. 29.42 in loin and 30.85 in case of hind leg. We also detected increasing levels of n-3 PUFA ($P < 0.001$) from control group (2.98 % in Loin and 5.10 % in leg meat) with respect to groups fed 7% flaxseed (T1) (5.38% in Loin and 8.13% in leg meat), 3.5 % flaxseed (T2) (3.55% in loin and 5.57% in leg meat) (14). The increased content of n-3 PUFA was able to reduce the n-6/n-3 PUFA ratio as evidenced in table 5. The increased content of n-3 PUFA was mainly due to the higher content of α-linolenic acid, which represents the main fatty acid of flaxseed. However the concentration of EPA and DHA found in both loin and leg meat was very low (About 0.1%) and not increasing from control to T2 group evidencing the limited efficiency of α-linolenic acid conversion to the long chain n-3 PUFA in rabbits. As stressed by (15), n-6/n-3 PUFA ratio should not use alone as evaluation index of the nutritive value of meat. The effectiveness of whole linseed to increase the PUFA and α-linolenic acid contents of the meat has been previously reported by several

Table 4 Fatty acid profile (% of total fatty acid) and fatty acid ratio of selected fatty acid-related indexes

Fatty acid profile of loin				fatty acid profile of leg			
Fatty acid composition (%)	T0	T1	T2	T0	T1	T2	p-value
C14,0	1.22	1.84	1.96	1.80	2.34	2.25	*
C16,0	27.93	26.99	26.87	25.74	24.21	23.91	*
C18,0	6.12	7.47	7.24	5.08	6.38	6.28	Ns
SFA	39.26	35.63	36.07	36.61	32.93	32.44	**
C14,1	0.07	0.03	0.20	0.13	0.08	0.06	Ns
C16,1	0.61	2.86	3.73	1.77	4.18	3.52	**
C18,1	23.03	24.73	25.48	24.57	26.09	27.27	*
MUFA	23.71	27.62	29.42	26.47	30.35	30.85	**
C18,2	22.82	23.06	24.13	24.02	24.47	26.95	*
C18,3	2.98	5.38	3.55	5.10	8.13	5.57	**
C20,3	7.44	0.26	0.30	7.33	0.16	0.12	**
C22,5	1.18	0.62	0.40	0.74	0.11	0.09	*

C22,6	0.23	0.15	0.19	0.25	0.17	0.11	Ns
PUFA	34.65	29.46	28.57	37.44	33.04	32.84	*
UFA	58.36	57.08	57.99	63.91	63.40	63.69	*
SFA/UFA	0.67	0.62	0.62	0.57	0.52	0.51	Ns
PUFA/SFA	0.88	0.83	0.79	1.02	1.00	1.01	*

*Significant ** Highly significant Ns Non-significant

studies on both rabbits (16) and other species (17). Seeing that 3.5% dietary flaxseed determined a n-3 PUFA content of 8.13% of the total fatty acids in hind leg. It can be predicted that a content of 396 mg n-3 PUFA/100g meat which signifies about 19% of suggested daily allowance (RDA) for n-3 PUFA by (18).

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