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Carcass Characteristics of Piglets Supplemented with Probiotics

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A feeding trial for 90 days was conducted in Twenty-four Large White Yorkshire piglets distributed into four treatment groups, fed respectively with basal diet without probiotic, basal diet with freeze dried *Lactobacillus acidophilus* (1.0 x10^6 CFU/g of feed, basal diet with freeze dried *Lactobacillus plantarum* (1.0 x10^6 CFU/g of feed), basal diet with freeze dried *Lactobacillus acidophilus* (1.0 x10^3 CFU/g of feed and *Lactobacillus plantarum* (1.0 x10^3 CFU/g of feed). No significant (P<0.05) variation was observed in carcass weight, dressing percentage, back fat thickness, carcass length, internal organ weights, jowl, picnic shoulder, loin and ham percentage. Piglets in probiotic supplemented groups showed significantly higher percentage of, Boston Butt and Loin. Significantly highest (P<0.05) oleic, linolenic, palmitoleic and eicosopentanoic acid was in piglets supplemented *Lactobacillus plantarum*1.0 x10^3 CFU/g of feed *and Lactobacillus acidophilus* 1.0 x10^3 CFU/g of feed.

Introduction

Nutritionally pork is a source of good quality protein and excellent source of vitamins and minerals. Hence, there is an ever-increasing demand for pork. Global pork production for the past two decades has shown an increasing trend to the tune of 2 per cent annually. However, pork is also a rich source of fat, it contains 10 to 16% fat, both saturated fatty acids and unsaturated fatty acids are present in pork fat in equal quantity. Increasing awareness about healthy food has led to increasing interests on natural foodstuffs and nutraceuticals such as probiotics (Park *et al.*, 2016). Lactobacillus being the most commonly used probiotic agent improves growth performance, feed conversion efficiency, intestinal microbiota, nutrient utilization, gut health and regulates the pigs' immune system (Dowarah *et al.*, 2017). Probiotic administration could be useful to modify and improve the fatty acid profile of pig meat (Ross *et al.*, 2012). Hence a study was undertaken to study the carcass characteristics of piglets supplemented with probiotics.

Materials and Methods

A feeding trial for 90 days was conducted in piglets in Pig Breeding Unit of Post Graduate

Research Institute in Animal Sciences, Kattupakkam. Twenty-four Large White Yorkshire piglets 42 ± 2 days of age (12 males and 12 females) with an average weight of 9.4 ± 0.26 kg, were randomly distributed into four treatment groups with six piglets (3 males and 3 females) in each group. Treatment 1 was piglets fed with basal diet without probiotic supplement. Treatment 2 was piglets fed basal diet supplemented with freeze dried *Lactobacillus acidophilus* (1.0 x10^6 CFU/g of feed). Treatment 3 were piglets fed basal diet supplemented with freeze dried *Lactobacillus plantarum* (1.0 x10^6 CFU/g of feed).Treatment 4 were piglets fed basal diet supplemented with freeze dried *Lactobacillus acidophilus* (1.0 x10^3 CFU/g of feed and *Lactobacillus plantarum* (1.0 x10^3 CFU/g of feed).Ingredient composition and calculated nutritive value of the basal diet fed to the experimental animals is presented in Table 1.

At the end of the trial, three piglets all male from each treatment group were selected and were kept off feed for a period of 12 hours prior to slaughter but given *ad libitum* access to water. The pre-slaughter live weights of the animals were recorded. The animals were stunned with electrical stunner and then dressed as per standard procedure. Following exsanguination, kidneys, heart, lungs, liver excluding gall bladder, spleen were removed and weighed to document organ weights and were expressed as per cent carcass weight. The weight of dressed carcass, after the removal of head and shanks were recorded immediately. The carcass was weighed; carcass weight was expressed in kg. Carcass characteristics were determined as per the procedure of Singh *et al.,* (1983). Back fat thickness was measured along the vertebral column at the first rib, last rib and last lumbar vertebrae using the back fat thickness gauge. The average of three values was expressed as back fat thickness of the carcass. The thickness of the skin was also included in the measurement and expressed in inches (Ziegler, 1968).The carcass was cut as per standard cut up parts *viz.,* jowl, boston butt, picnic shoulder, bacon, ham. The cuts were individually weighed and expressed as per cent dressed weight. Loin eye area is the cross sectional area of the *longissimus dorsi* muscle between the 10^{th} and 11^{th} intercostal space. The area was traced on the butter paper by pressing the paper against the cut surface of the loin eye muscle. The traced muscle area was measured with compensation polar planimeter and expressed in centimetre square (Lefaucheur *et al.,* 1991).

The fatty acid composition of loin eye muscle was analysed using Gas Chromatography (GC). The standardization of fatty acid profile was done with egg yolk lipid as per the procedure described by Wang *et al.,* (2000). The fatty acids analysed included myristic acid, palmitic acid, stearic acid, behenic acid, arachidic acid, oleic acid, linoleic acid, linolenic acid, palmitoleic acid, ecosapentaenoic acid, docosahexaenoic acid and other fatty acids, the values of which were expressed as per cent total fat.

The data collected on various parameters were grouped and subjected to statistical analysis by one way ANOVA as per the procedure of statistical analysis system (SPSS, version 20.0 for windows). All the percentage values in the experiment were transformed to their arcsine roots before subjecting to statistical analysis.

Results and Discussion

The carcass characteristics of piglets supplemented without or with probiotics are presented in Table 2.

No significant (P<0.05) variation was observed in carcass weight, dressing percentage, back fat thickness and carcass length. However the loin eye area of T_3- *Lactobacillus plantarum* 1.0x10^6 CFU/g of feed (19.07 ± 0.18) and T_4- *Lactobacillus plantarum*1.0x10^3 CFU/g and *Lactobacillus acidophilus* 1.0x10^3 CFU/g of feed (19.33± 0.76) was significantly higher than T_1 - without probiotic supplement (16.83 ± 1.17) and T_2 - *Lactobacillus acidophilus* 1.0x10^6 CFU/g of feed.

The internal organs weight (%, live weight) and cut up parts (%, dressed weight) of piglets supplemented without or with probiotics are presented in Table 3.

No significant (P<0.05) variation was observed in per cent internal organs weights of piglets supplemented without or with probiotic. No significant (P<0.05) variation was observed in the jowl, picnic shoulder, loin and ham percentage of piglets supplemented without or with probiotics. However, piglets in probiotic supplemented groups showed significantly higher percentage of Boston Butt and Loin. Whereas piglets in probiotic supplemented groups showed significantly lower percentage of bacon. Rahaman *et al.*, (2015) also reported no variation in carcass characteristics of probiotic supplemented groups. Jasek *et al.*, (1992) fed diets containing the addition of the probiotic Biogen T to growing pigs and they stated the improvement of loin "eye" area by 7.6%. As in the study, Balasubramanian *et al.*, (2016) also reported no significant variation in back fat thickness of swine supplemented with probiotics. Sudikas *et al*., (2010), studied the effects of probiotics (*Bacillus licheniformis* and *Bacilus subtilis*) on the carcass, meat and fat quality of pigs and reported that 0.04 per cent probiotic had no influence on carcass quality, however 0.06 per cent supplementation of probiotic increased the carcass weight by 5.9 per cent and lean meat by 1.72 per cent compared to control. Rybarczyk *et al.*, (2015) reported that supplementation of Bokashi probiotic lead to higher meat percentage, thicker *Longissimus dorsi* muscle, lower fat percentage, with a hot carcass weight similar to control.

Table.1 Ingredient composition and calculated nutritive value of basal diet offered to piglets

Ingredient	Inclusion level (%)
Maize	60.00
Soya bean meal	23.70
Fish meal	06.00
DORB	01.30
Oil	06.30
Salt	00.30
Monosodium phosphate	00.50
Mineral mix	01.50
Lysine	00.20
Methionine	00.20
Total	100.00
Calculated Nutritive value	
Metabolisable Energy (Kcal /kg)	3360
Crude Protein (%)	20

Table.2 Carcass characteristics of piglets supplemented without or with probiotic (Mean* ± SE)

Carcass characteristics	T_1 without probiotic supplement	T_2 *Lactobacillus acidophilus* 1.0x10^6 CFU/g of feed	T_3 *Lactobacillus plantarum* 1.0x 10^6 CFU/g of feed	T_4 *L. plantarum* 1.0x 10^3 CFU/g of feed *and* *L. acidophilus* 1.0x10^3 CFU/g of feed
Carcass weight(Kg)	33.09 ± 3.77	34.19 ± 1.25	39.33 ± 0.23	41.43 ± 3.66
Dressing percentage (%)	65.18 ± 1.18	68.35 ± 3.77	67.67 ± 1.93	70.68 ± 0.75
Carcass length (cm)	73.93 ± 3.20	70.33 ± 1.20	76.43 ± 2.248	77.96 ± 5.01
Back fat thickness (cm)	3.30 ± 0.11	2.91 ± 0.17	2.94 ± 0.12	2.62 ± 0.38
Loin eye area (cm^2)	16.83^a ± 1.17	16.00^a ± 0.50	19.07^b ± 0.18	19.33^b ± 0.76

*Mean of three observations
Means bearing different superscripts within a row differ significantly (P<0.05)

Table.3 Internal organs weights (%, live weight) and cut up parts (%, dressed weight) of piglets supplemented without or with probiotic (Mean* ± SE)

Internal organs weights (%, live weight)	T_1 without probiotic supplement	T_2 *Lactobacillus acidophilus* 1.0x10^6CFU/g of feed	T_3 *Lactobacillus plantarum* 1.0x 10^6CFU/g of feed	T_4 *L. plantarum* 1.0x 10^3CFU/g of feed *and* *L. acidophilus* 1.0x10^3CFU/g of feed
Heart	0.40 ± 0.05	0.37 ± 0.02	0.37 ± 0.04	0.39 ± 0.02
Trachea and lung	1.04 ± 0.091	0.97 ± 0.00	0.96 ± 0.00	0.95 ± 0.31
Liver	2.23 ± 0.09	2.03 ± 0.163	1.88 ± 0.17	1.98 ± 0.11
Spleen	0.30 ± 0.07	0.21 ± 0.00	0.25 ± 0.42	0.23 ± 0.03
Gastro Intestinal Tract	14.08 ± 0.97	11.21 ± 0.91	12.61 ± 0.14	12.37 ± 1.52
Kidney	0.41 ± 0.03	0.41 ± 0.05	0.378 ± 0.03	0.37 ± 0.01
Jowl	7.65 ± 0.474	7.51 ± 0.650	8.17 ± 0.78	8.37 ± 0.19
Boston butt	15.51a ± 0.85	19.75b ± 0.63	19.08b ± 0.63	17.23ab ± 0.82
Picnic shoulder	20.31 ± 1.06	19.478 ± 0.47	22.28 ± 0.41	20.00 ± 1.14
Loin	17.22a ± 1.83	21.03ab ± 0.97	19.80ab ± 1.89	21.84b ± 0.60
Bacon	12.59b ± 1.04	10.16ab ± 0.75	10.59ab ± 0.79	9.14a ± 0.79
Ham	21.35 ± 1.16	18.13 ± 0.72	19.02 ± 0.21	17.03 ± 1.39

*Mean of three observations
Means bearing different superscripts within a row differ significantly (P<0.05)

Table.4 Fatty acid (% total fat) profile of loin muscle of piglets fed basal diet supplemented without or with probiotic (Mean* ± SE)

Fatty acids (% of total fat)	T_1 without probiotic supplement	T_2 *Lactobacillus acidophilus* 1.0x10^{6}CFU/g of feed	T_3 *Lactobacills plantarum* 1.0x 10^{6}CFU/g of feed	T_4 *L. plantarum* 1.0x 10^{3}CFU/g of feed *and L. acidophilus* 1.0x10^{3}CFU/g of feed
Saturated fatty acids				
Myristic acid	1.58 ± 0.08	1.53 ± 0.09	1.62 ± 0.02	1.51 ± 0.09
Palmitic acid	26.72 ± 0.06	25.67 ± 0.57	26.30 ± 0.13	25.46 ± 0.64
Stearic acid	11.21 ± 0.40	11.73 ± 0.03	11.76 ± 0.06	12.18 ± 0.28
Behenic acid	0.77^{c} ± 0.02	0.61^{bc} ± 0.03	0.53^{b} ± 0.00	0.36^{a} ± 0.00
Arachidic acid	0.36 ± 0.00	0.39 ± 0.02	0.36 ± 0.02	0.37 ± 0.05
Unsaturated fatty acids				
Oleic acid	43.71^{a} ± 0.05	44.29^{ab} ± 0.38	44.93^{bc} ± 0.26	45.37^{c} ± 0.02
Linoleic acid	10.65 ± 0.55	10.740 ± 0.39	11.19 ± 0.18	11.90 ± 0.55
Linolenic acid	0.32^{a} ± 0.03	0.34^{ab} ± 0.00	0.39^{b} ± 0.01	0.40^{b} ± 0.03
Palmitoleic acid	2.35^{a} ± 0.18	2.74^{ab} ± 0.08	2.58^{ab} ± 0.20	2.99^{b} ± 0.00
Eicosapentaenoic acid	0.13^{a} ± 0.00	0.13^{a} ± 0.00	0.18^{ab} ± 0.02	0.24^{b} ± 0.02
Docosahexaenoic acid	0.29 ± 0.01	0.32 ± 0.00	0.29 ± 0.02	0.31 ± 0.01
Others	0.75 ± 0.04	0.89 ± 0.08	0.89 ± 0.00	0.91 ± 0.08

*Mean of three observations
Means bearing different superscripts within a row differ significantly (P<0.05)

The fatty acid (% total fat) profile of loin muscle of piglets fed basal diet supplemented without or with probiotic is presented in Table 4.

Saturated fatty acid profile of loin muscle of piglets fed basal diet supplemented without or with probiotic showed no significant variation, except for Behenic acid which was significantly higher (0.77± 0.02) in muscle of piglets fed basal diet without probiotic supplementation.

Probiotic supplementation significantly (P<0.05) increased unsaturated fatty acid (oleic, linolenic, palmitoleic and eicosopentanoic acid) levels in muscle of piglets, compared to their levels in muscle of piglets without probiotic supplementation. However no significant (P<0.05) variation was observed in linoleic acid and docosohexanoic acid levels in muscles of animals irrespective of the various treatments. Significantly highest (P<0.05) oleic, linolenic, palmitoleic and eicosopentanoic acid was in piglets supplemented *Lactobacillus plantarum* 1.0 x10^{3}CFU/g of feed *and Lactobacillus acidophilus* 1.0 x10^{3}CFU/g of feed.

Similar to the findings of this study in another study, tissues from the probiotic group animals exhibited an increase in monounsaturated and polyunsaturated fatty acids; Furthermore, linoleic acid (C18:2), linolenic acid (18:3), and cis-9, trans-11 conjugated linoleic acid (CLA) concentrations were significantly higher ($P< 0.05$) compared to the control group (Ross *et al*., 2012).

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