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Running Title (within 10 words)	<i>Lactiplantibacillus plantarum</i> CAM-6 effects in growing pigs
Author	Cesar Augusto Betancur Hurtado ¹ , Jinyoung Lee ² , Martin Nyachoti ²
Affiliation	1 Department of Livestock Sciences, School of Veterinary Medicine and Animal Husbandry, University of Córdoba, Monteria 230002, Colombia 2 Department of Animal Science, University of Manitoba, Winnipeg, Manitoba, Canada. R3T 2N2
ORCID (for more information, please visit https://orcid.org)	Cesar Betancur (http://orcid.org/0000-0001-7617-2202) Jinyoung Lee (https://orcid.org/0000-0002-9042-5314) Martin Nyachoti (https://orcid.org/0000-0001-7075-7226)
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CORRESPONDING AUTHOR CONTACT INFORMATION

For the corresponding author (responsible for correspondence, proofreading, and reprints)	Fill in information in each box below
First name, middle initial, last name	Cesar Betancur
Email address – this is where your proofs will be sent	cbetancour@correo.unicordoba.edu.co
Secondary Email address	
Address	Department of Livestock Sciences, School of Veterinary Medicine and Animal Husbandry, University of Córdoba. Monteria 230002, Colombia
Cell phone number	

Office phone number	
Fax number	

6 Abstract (up to 350 words)

7 This study evaluated the effects of oral supplementation with *Lactobacillus plantarum* CAM-6 on the biochemical
 8 profile, carcass traits, textural properties, chemical composition, and meat quality of growing pigs. Thirty-six castrated
 9 male pigs [(Landrace × Pietrain) × Duroc] were randomly allocated to three dietary treatments (n = 3 pens, 12 pigs
 10 per treatment) from 49 to 139 days of age: a basal diet without additives (CTRL), a positive control supplemented
 11 with a subtherapeutic antibiotic (TRT1), and the basal diet supplemented with 5 mL/day of a preparation containing
 12 *L. plantarum* CAM-6 (5 mL/day at 5×10^9 CFU/mL, equivalent to 2.5×10^{10} CFU/pig/day; TRT2). Pigs supplemented
 13 with *L. plantarum* CAM-6 exhibited lower plasma glucose, triglycerides, and total cholesterol concentrations, along
 14 with increased phosphorus reabsorption ($p < 0.05$). Carcass evaluation revealed improved edible yield and reduced
 15 dorsal fat deposition in TRT2 compared with TRT1 ($p < 0.05$). Meat from the probiotic group also displayed reduced
 16 crude fat content and cooking loss ($p < 0.05$), as well as superior sensory characteristics, including lower toughness
 17 and enhanced aroma, flavor, and color, relative to CTRL and TRT1. These findings indicate that *L. plantarum* CAM-
 18 6 delivered as a fruit-based biopreparation may enhance metabolic health, carcass performance, and meat quality in
 19 growing pigs, supporting its use as a viable alternative to subtherapeutic antibiotic growth promoters.

21 **Keywords (3 to 6):** Lactic acid bacteria, backfat thickness, blood biochemistry, meat texture, native probiotic, sensory
 22 analysis

24 Introduction

25 A major goal for the swine industry is to produce high-quality pork products that meet consumer demands for safe,
 26 nutritionally valuable, and sensory appealing. Achieving these traits is critical for maintaining competitiveness and
 27 consumer trust in meat products [1]. To this end, there is a global desire to adopt production practices that are well
 28 aligned with consumer values. Thus, the swine industry in many jurisdictions has discontinued the use of antimicrobial
 29 growth promoters in favor of alternatives such as the use of probiotics [2,3].

30 Lactic acid bacteria (LAB), particularly genera such as *Lactobacillus*, are among the most frequently
 31 employed probiotic microorganisms due to their ability to colonize the gastrointestinal tract, regulate microbial
 32 equilibrium, and produce beneficial metabolites [4]. *Lactobacilli* contribute significantly to energy metabolism in pigs
 33 by enhancing gastrointestinal tract integrity, which in turn improves nutrient digestibility, metabolic efficiency, and
 34 ultimately meat quality [5]. The administration of *Lactiplantibacillus plantarum* (formerly *Lactobacillus plantarum*)

to weanling pigs has been shown to enhance meat texture indices, suppress opportunistic pathogens, and promote increased intestinal villus height, reflecting improved gut-barrier integrity and nutrient absorption [6,7,8]. Although probiotics and fermented feeds have been widely evaluated for pork quality [5,9,10], information remains scarce on a native *Lactiplantibacillus plantarum* and delivered as a fruit-based biopreparation, with respect to its combined effects on meat quality in growing pigs under Colombian production conditions. Therefore, this study aimed to determine the effects of dietary supplementation with a native probiotic strain (*Lactiplantibacillus plantarum* CAM-6 on carcass traits and the physicochemical composition of the Longissimus dorsi muscle in growing pigs.

Materials and Methods

Ethical Statement

All procedures involving animals were carried out in compliance with the regulations of the National Institute of Animal Health. The study protocol was reviewed and approved by the Research Ethics Committee of the University of Córdoba, Colombia (Approval No. 001, January 26, 2020).

Probiotic, Animals, and Experimental Treatments

A *Lactiplantibacillus plantarum* strain probiotic, previously isolated from hairless Creole pigs and incorporated into a fruit-based biopreparation (papaya, pineapple, and banana peels) and deposited in GenBank under the accession number MK523644.1, was used in this study [11].

A total of 36 castrated male crossbred pigs [(Landrace × Pietrain) × Duroc] with an initial body weight of 12.5 ± 0.18 kg were housed in groups of four per pen ($4 \times 2 \times 0.6$ m). Each pen served as an experimental unit and was equipped with a concrete floor, prefabricated concrete walls, linear cane feeders, and metallic nipple drinkers. Pigs were dewormed and vaccinated against classical swine fever at 28 days post-weaning, and no therapeutic medications were administered during the experimental period. Three pens were randomly allotted to each of three experimental treatments, giving 12 pigs per treatment from 49 to 139 days of age. Experimental treatments were: (i) control (CTRL) in which pigs were fed a diet without any additives, (ii) Treatment 1 (TRT1) in which pigs were fed the CTRL supplemented with 350 mg/kg colistin sulfate (20% active ingredient) as a growth promoter, and (iii) Treatment 2 (TRT2) in which pigs were fed the CTRL diet and given an oral suspension containing *Lactiplantibacillus plantarum* CAM-6 at 5×10^9 CFU/mL once daily at 0700h using a syringe. Diets were formulated to meet the nutritional requirements for pigs weighing 10–50 kg according to the most recent swine nutrition guidelines, as shown

in Table 1 [12]. Feed was offered *ad libitum* twice daily (0800 and 1500h), and pigs had unrestricted access to fresh water throughout the 90-day trial. The study was conducted at the Swine Research Laboratory of the University of Córdoba, Berástegui Campus, Córdoba, Colombia.

Sample Collection and Pig Slaughter

At the end of the trial (139 days of age), 5 mL of blood was collected from all pigs via jugular venipuncture into Vacutainer tubes containing lithium heparin as the anticoagulant (BD Vacutainer®, Franklin Lakes, NJ, USA) following an overnight fast. Samples were immediately stored on ice and transported to the laboratory, where they were maintained at 4°C before centrifugation at 3000 rpm for 15 min at 24°C (Eppendorf Centrifuge AG, New York, NY, USA) to obtain plasma. Following blood collection, four pigs per treatment were randomly selected and euthanized for carcass evaluation at the Experimental Slaughterhouse of the Faculty of Veterinary Medicine and Zootechnics, University of Córdoba, Berástegui Campus. Pigs were sedated with Xylazine (Rompum® intramuscularly) in accordance with recommended sedation protocols for swine and exsanguinated through the jugular vein.

To evaluate carcass characteristics, each carcass was divided into the following commercial cuts: loin, shoulder, leg, and ribs. Dorsal fat thickness was recorded, and the Longissimus dorsi muscle was excised from each slaughtered pig (n = 12) and stored at -20°C for subsequent analyses. The relative weight of edible tissues was calculated as a proportion of the live body weight at slaughter.

Sample Analysis

Plasma samples were analyzed at the Veterinary Clinical Laboratory of the Faculty of Veterinary Medicine and Zootechnics, University of Córdoba, for the following biochemical metabolites: total protein, albumin, globulins, urea, glucose, cholesterol, triglycerides, magnesium (Mg), calcium (Ca), and phosphorus (P). Analyses were performed using commercial enzymatic assay kits, and absorbance was read with an ultraviolet-visible spectrophotometer (Metrolab 1600, Winner, USA). Meat samples were analyzed for dry matter (moisture), crude fat, ash, and crude protein content following official protocols [13], whereas texture attributes were determined using a TAXT Plus texture analyzer (Stable Micro Systems, Surrey, UK) equipped with a Warner–Bratzler blade (HDP/BSW) and Texture Exponent 32 software. Rectangular pork subsamples (1 × 1 × 4 cm) from each treatment were analyzed in triplicate to assess firmness and tenderness. The operating conditions were set as follows: pre-test speed 1 mm s⁻¹, test speed 1

mm s⁻¹, and post-test speed 10 mm s⁻¹. Cooking loss was determined according to the reference method described by Honikel [14], samples of the *Longissimus dorsi* muscle were collected from the hot carcass and weighed immediately (W₀). Each sample was individually wrapped in aluminum foil and cooked in a water bath until reaching an internal temperature of 70°C, monitored using a calibrated digital thermometer. Subsequently, the samples were cooled at 4°C for 24 h, gently blotted dry to remove surface moisture, and reweighed (W_f). Cooking loss was expressed as a percentage and calculated using the following equation: [% CL = [(W₀ - W_f) / W₀] × 100.

pH and Color Analysis

After 24 hours' post-mortem, meat samples (n = 4 per treatment) were allowed to equilibrate to room temperature (≈23°C), and pH was measured using a digital pH meter (Bantex 300A), previously calibrated with standard buffer solutions at pH 7.0 and 10.0. Meat color was evaluated on the *Longissimus dorsi* muscle using a ColorFlex EZ45 spectrophotometer (HunterLab®, Reston, VA, USA). The following CIELAB parameters were recorded: lightness (L*), redness (a*), yellowness (b*), saturation (C*), and hue angle (H°), under a D65 standard illuminant and 10° observer angle (ASTM E308). Measurements were taken in triplicate on each muscle sample.

Sensory analysis

Sensory attributes were evaluated by a panel of 20 trained assessors from the University of Córdoba, following the Colombian Technical Standard NTC 3932 [15]. Meat samples were cooked in water at 100°C for 30 min following a previously described protocol (like those used in food microbiology studies). The attributes assessed included aroma (normal, abnormal), flavor (normal, abnormal), hardness (normal, hard, very hard, very soft), and color (normal, pale, intense). Samples were served randomly on disposable plates at consumption temperature and accompanied by water for palate cleansing and an evaluation form.

Statistical analysis

Data were analyzed using a completely randomized design. Before ANOVA, data were checked for normality using the Kolmogorov–Smirnov test and for homogeneity of variances using Bartlett's test. When significant treatment effects were detected, means were separated using Duncan's multiple range test. Statistical analyses were performed using SPSS software (Version 21.0; IBM Corp., Armonk, NY, USA). Differences were considered statistically significant at $p < 0.05$.

Results

The effects of dietary supplementation with *Lactiplantibacillus plantarum* CAM-6 on the blood biochemical profile of growing pigs are presented in Table 2. No significant differences were detected among treatments for total protein, albumin, globulin, or urea levels. Pigs in TRT2 had lower blood levels of glucose and cholesterol compared to the CTRL and TRT1 ($p < 0.05$), but values for CTRL and TRT1 were not different. Pigs in TRT1 and TRT2 had not significantly different triglycerides concentrations, and both groups showed lower ($p < 0.05$) plasma triglycerides concentrations than in CTRL pigs. The plasma concentrations of Mg, Ca, and P were lower ($p < 0.05$) in TRT1 pigs compared to CTRL and TRT2 pigs, whereas TRT2 pigs had higher ($p < 0.05$) P concentration than the other groups.

Table 3 shows the effect of oral administration of *Lactiplantibacillus plantarum* CAM-6 on the yield of edible portions of the carcass of growing pigs. Overall, there was no effect of probiotic treatment (TRT2) except for the loin and back fat thickness, which were increased and decreased, respectively, by probiotic treatment compared with CTRL ($p < 0.05$). The carcass yield was significantly higher ($p = 0.05$) in the probiotic group (TRT2 = 69.9%) and the control group (CTRL = 68.84%) compared with the antibiotic group (TRT1 = 64.56%). Probiotic treatment (TRT2) consistently improved carcass quality indicators (i.e., higher loin, shoulder, and rib yields and reduced back fat) compared with the antibiotic treatment (TRT1).

As shown in table 4, the chemical composition of the *longissimus dorsi* muscle was not affected with respect to moisture, crude protein, or ash content. However, pigs receiving the probiotic biopreparation exhibited the lowest crude fat content ($p = 0.04$), compared with both the antibiotic-treated and control groups.

The effects of dietary supplementation with *Lactiplantibacillus plantarum* CAM-6 on meat quality traits are presented in Table 5. Cooking loss was significantly higher ($p < 0.05$) in the antibiotic group (TRT1; 40.36%) than in the control (CTRL; 35.82%) and probiotic (TRT2; 36.77%) groups. Firmness was significantly greater ($p < 0.05$) in the CTRL group than in the TRT1 group, whereas the TRT2 group showed intermediate values and did not differ significantly from either treatment. Tenderness was significantly improved ($p < 0.05$), as indicated by lower shear force values, in the TRT1 group compared with the CTRL and TRT2 groups. Muscle pH was significantly higher ($p < 0.05$) in the CTRL group than in the TRT1 and TRT2 groups.

Color parameters were significantly influenced by treatment ($p < 0.05$; Table 6). Meat from the TRT1 group exhibited greater lightness (L^*) than that from the CTRL and TRT2 groups, whereas the L^* values of CTRL and TRT2 did not differ significantly. The color saturation (C^*) was highest in TRT1, significantly greater than TRT2, while the

CTRL group showed an intermediate value that did not differ significantly from either TRT1 or TRT2. The probiotic treatment maintained stable color characteristics without causing excessive pigment darkening.

A higher percentage of samples with normal aroma was recorded in the probiotic group (TRT2, 95.0%) compared with both the CTRL and TRT1 (82.5%) ($p < 0.05$; Table 7). Conversely, the proportion of samples classified as having an abnormal aroma was markedly reduced in the probiotic treatment (TRT2; 5.0%). The probiotic (TRT2; 90%) and antibiotic groups (TRT1; 90%) achieved the highest frequency of normal flavor scores, while the control group (CTRL; 72.5%) presented more samples with abnormal taste perception (27.5%). Texture evaluation showed significant differences among treatments. The probiotic group (TRT2) had a higher ($p < 0.05$) proportion of samples with normal (52.5%) and very soft (15.0%) textures, along with fewer ($p < 0.05$) hard samples compared to CTRL and TRT1, or very hard samples compared with TRT1.

Discussion

Feed additives such as probiotics are routinely added to swine diets because of their ability to improve pig gut health, nutrient digestibility, and growth performance [16,17]. Among the bacteria used as probiotics, those belonging to the *Lactobacillus* spp have received considerable attention because of their proven ability to tolerate gastric acid and bile and to adhere to the intestinal mucosa, which are essential prerequisites for survival and colonization in the gastrointestinal tract [18]. In a previous study, oral administration of a probiotic biopreparation containing *Lactobacillus plantarum* CAM6 was shown to improve growth performance and carcass traits in growing pigs [19], suggesting that this probiotic may positively influence nutrient utilization and muscle deposition.

Probiotic supplementation may modulate various metabolic processes, leading to changes in nutrient utilization. To this end, pigs supplemented with the probiotic had lower blood glucose, cholesterol, and triglycerides concentrations compared to controls. This effect may be associated with probiotic-induced changes in the gut microbiota and the production of microbial metabolites, such as short-chain fatty acids; particularly propionate produced by intestinal fermentation activities of *Lactobacillus* and other beneficial bacteria, inhibit hepatic cholesterol synthesis through down-regulation of 3-hydroxy-3-methyl-glutaryl-coenzyme A reductase and enhance bile acid hydrolysis and fecal excretion, thereby reducing micellar cholesterol absorption in the small intestine [20, 21]. More broadly, meta-analyses and controlled trials indicate that consumption of *L. plantarum* and similar strains lowers total cholesterol and low-density lipoprotein cholesterol [22]. The probiotic may exert a hypocholesterolemia effect by modulating hepatic cholesterol synthesis and bile-acid metabolism [23,24], whereas the effect on plasma glucose

concentration may be linked to the β -glucosidase activity of *L. plantarum*. This enzyme, isolated from porcine *L. plantarum* strains, facilitates the hydrolysis of complex carbohydrates into simpler sugars, thereby mitigating glucose levels [25]. Furthermore, recent reviews have established that probiotic supplementation supports glucose homeostasis via multiple pathways, including modulation of gut microbiota, enhancement of short-chain fatty acid production, and decreased oxidative stress [26].

The bioavailability of minerals to the host, such as Ca, Mg, and P, may be increased with the supply of probiotics, since lowering the pH facilitates the ionization of minerals, which is a requirement for their absorption [27]. In this regard, Collins et al. [28] reported that the highest digestibility of these nutrients was observed in pigs to which microbial additives were applied. Recent studies have confirmed that *Lactiplantibacillus plantarum* improves phosphorus utilization through acidification and modulation of gut microbiota activity [29]. Although the plasma concentrations of Mg and Ca were not different between the control and probiotics groups, supplementing pigs with the bio-preparation *Lactobacillus plantarum* CAM-6 increased plasma P concentration in the current study.

The results of the current study indicate that treatment with *Lactiplantibacillus plantarum* CAM-6 enhanced the yield of edible parts, which may have been due to the *L. plantarum* CAM-6 strain enhancing the pigs' energy and nutrient metabolism. These findings align with the report of Betancur and Martínez [30], who demonstrated that oral administration of *L. plantarum* CAM-6 improved intestinal structure and positively modulated the gut microbiota in growing pigs. Because probiotics act primarily within the gastrointestinal tract rather than directly on muscle, the link between intestinal modulation and carcass traits is necessarily indirect [31]. One thing to note is the carcass characteristics were evaluated at approximately 50 kg body weight, reflecting local production practices in Colombia, and the results may differ in production systems where pigs are slaughtered at heavier market weights.

Lactic acid bacteria in the gut, particularly *Lactiplantibacillus plantarum*, may enhance the yield of edible parts through various mechanisms, including improving intestinal barrier integrity, modulating the gut microbiota, and enhancing nutrient digestion and absorption. These effects promote more efficient nutrient utilization and tissue deposition, thereby contributing to greater muscle development and carcass yield, as reported in finishing pigs supplemented with dietary probiotics [32].

Backfat thickness is widely recognized as a reliable indicator of total adiposity in pigs because it is easily measurable, represents a major fraction of carcass fat, and closely correlates with overall fatness [33]. Results of the current study show that supplementation with *Lactiplantibacillus plantarum* CAM-6 reduced backfat thickness, which is consistent with reports of others showing that probiotic or fermented-feed supplementation can modulate lipid

metabolism, reduce backfat thickness, and improve carcass composition and lipid quality in pigs [34]. The reduction in backfat thickness observed in probiotic-supplemented pigs may be explained by the lipase-inhibitory and lipid-modulating properties of *Lactiplantibacillus plantarum*. Previous studies demonstrated that *L. plantarum* FH185 exhibits significant pancreatic lipase inhibition, limiting triglyceride accumulation and adipocyte differentiation [35]. Similarly, *Lactiplantibacillus plantarum* KC3 has enhanced lipase-inhibitory capacity and the ability to regulate lipid metabolism, resulting in improved carcass leanness and fat quality [36]. Therefore, modulation of lipoprotein lipase activity by *Lactiplantibacillus plantarum* may reduce lipid deposition, consistent with the lower intramuscular fat content observed in the Longissimus dorsi muscle of probiotic-supplemented pigs.

The significantly lower crude fat content observed in the *longissimus dorsi* muscle of pigs supplemented with *Lactiplantibacillus plantarum* CAM6 suggests that this probiotic modulated lipid metabolism and fat deposition. This finding is consistent with previous reports showing that *Lactobacillus* spp. can influence lipid metabolism by regulating lipoprotein lipase activity, adipogenesis, and triglyceride deposition, thereby reducing fat accumulation in growing pigs [37]. This reduction in crude fat content improves carcass leanness and may enhance the nutritional value of pork, particularly benefiting consumers at risk of cardiovascular diseases [38,39,40].

The reduced cooking loss may reflect an improvement in the water-holding capacity of the longissimus dorsi muscle associated with *Lactiplantibacillus plantarum* CAM6 supplementation. Improved water-holding capacity is a desirable meat quality trait because it minimizes moisture loss during cooking and enhances product yield. Similar reductions in cooking loss have been consistently reported in pigs receiving dietary probiotic supplementation, supporting the beneficial effects of probiotics on pork quality [41]. Further, dietary probiotics such as *Lactiplantibacillus plantarum* have been reported to attenuate lipid peroxidation by enhancing endogenous antioxidant defense mechanisms [42]. These findings support the hypothesis that dietary probiotics maintain muscle-cell membrane integrity and reduce lipid peroxidation, thereby limiting fluid exudation and improving meat quality [43].

Post-mortem pH is a critical determinant of meat quality, influencing water-holding capacity and texture. Oxidative processes can delay or alter pH decline by damaging muscle proteins and cell membranes, thus impairing structural integrity and fluid retention [44]. Antioxidant mechanisms stimulated by probiotic supplementation, such as those enhanced by *Lactiplantibacillus plantarum*, help maintain redox balance, limit lipid peroxidation, and preserve the acidification process of the muscle [42]. In this regard, Suo et al. [45] reported a lower pH in pork from pigs supplemented with *L. plantarum* compared with animals receiving antibiotics, suggesting that improved antioxidant status contributes to better muscle metabolism and overall meat quality.

Probiotic supplementation did not alter meat color compared with control group in the present study. However, pigs fed the antibiotic diet exhibited higher L* and C* values compared to control and probiotic groups. These findings suggest that *L. plantarum* CAM-6 helped maintain meat color stability by preventing the increases in L* and C* observed in the antibiotic group. This observation indicates that supplementing pigs with the probiotic maintains muscle integrity because higher L* and C* values are associated with poor water-holding capacity and increased cooking loss [46]. Indeed, a previous study has reported that L* values of pork loin were significantly associated with the cooking loss of pork belly, supporting the use of lightness as an indicator related to water-holding capacity [47]. This result is in correspondence with the greater exudation of water, precisely in the group to which antibiotics were administered (TRT1). Increased moisture on the muscle surface due to reduced water-holding capacity enhances light scattering, resulting in higher lightness (L*) and greater color saturation (C*) [48].

Probiotic supplementation showed significant improvements across all meat sensory indicators. Specifically, pigs supplemented with the *L. plantarum* CAM-6 biopreparation exhibited superior aroma, flavor, toughness, and color scores compared with the control group. These improvements may be attributed to the ability of the probiotic to modulate intestinal microbiota, leading to downstream effects on lipid metabolism [49]. These effects may influence the generation and profile of volatile compounds that impact pork aroma during storage and cooking. Probiotic supplementation may also promote endogenous antioxidant activity and reduce free radical formation, which in turn reduces rancidity and the formation of off-flavors and enhances consumer acceptability. These activities contribute to the stabilization of lipids and proteins, thereby enhancing meat oxidative stability and sensory quality, as reflected in Table 7. Collectively, these mechanisms support the probiotic's role as an effective microbial additive to reduce oxidative deterioration in meat products [50]. Panelists consistently reported improved tenderness and juiciness in meat from animals receiving *L. plantarum* CAM-6, which aligns with the enhanced oxidative stability and sensory performance described previously. For instance, dietary supplementation with *Lactobacillus plantarum* strains in pigs has been associated with improved pork sensory attributes and altered volatile profiles, consistent with a gut–muscle/metabolism axis [51].

Several limitations of this study should be acknowledged. First, only pigs in the probiotic group received oral administration by syringe. Although the procedure was brief and did not require restraint, future studies should administer an equivalent volume of saline to the control groups to eliminate any potential confounding effect of the administration procedure. Another limitation of this study is that the probiotic was evaluated only within the fruit-based biopreparation, making it impossible to determine whether the observed effects were due to *L. plantarum* CAM-

6, the matrix itself, or their interaction. Future studies including separate probiotic-only and matrix-only treatments are needed to distinguish these effects.

In conclusion, results of the current study demonstrate that oral supplementation with a native probiotic strain (*Lactiplantibacillus plantarum* CAM-6) to growing pigs improves, carcass composition, and meat quality characteristics. These findings imply that in addition to the commonly acknowledged role of dietary probiotics in enhancing gut health and function in pigs, their supplementation may also support production of meat products that are not only nutritionally adequate but also that offer a superior eating experience for consumers. It can be expected that collectively these attributes will positively contribute to long-term sustainability of the swine industry.

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420 Table 1. Formulated to meet the nutritional requirements of growing pigs.

Ingredient	%
Corn	41.24
Soy flour	16.00
Wheat bran	18.29
Soy cake	13.47
Sorghum	7.00
Mineral-vitamin premix ¹	4.00
Calculated composition	
Metabolizable energy, kcal/kg	3,200
Crude protein, %	18.00
Calcium, %	1.13
Total phosphorus, %	0.95

421 ¹The vitamin and mineral premix provided per kilogram of food: 20,000 IU vitamin A; 4,000 IU
 422 vitamin D₃; 80 IU vitamin E; 16 mg vitamin K; 4 mg thiamine; 20 mg riboflavin; 6 mg pyridoxine;
 423 0.08 mg vitamin B₁₂; 120 mg niacin; 50 mg calcium pantothenate; 2 mg folic acid; 0.08 mg biotin;
 424 15 mg Cu (as copper sulfate); 56 mg Zn (as zinc oxide); 73 mg Mn (as manganese oxide); 0.3 mg
 425 I (as potassium iodate); 0.5 mg Co (as Co₂O₃·7H₂O); 0.4 mg Se (as Na₂SeO₃·5H₂O).

426 Table 2. Effect of a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 on the blood
 427 biochemistry of growing pigs

Item	CTRL	TRT1	TRT2	SEM	p-value	Reference
Total protein, g/dL	5.84	5.79	5.80	0.21	0.946	4.4-7.4
Albumin, g/dL	3.71	3.09	3.41	0.30	0.458	1.9-3.9
Globulin, g/dL	2.13	2.57	2.50	0.16	0.114	0.5-2.6
Urea, mg/dL	18.78	20.36	18.39	0.71	0.082	5.4-29.4
Glucose, mg/dL	114.8 ^a	112.62 ^a	102.25 ^b	3.28	0.027	63-133
Cholesterol, mg/dL	118.76 ^a	116.76 ^a	75.68 ^b	9.15	0.041	127-151
Triglycerides, mg/dL	54.05 ^a	46.00 ^b	44.99 ^b	2.38	0.018	34-60
Mg, mg/dL	3.74 ^a	1.86 ^b	3.31 ^a	0.61	0.017	2.19-2.67
Ca, mg/dL	8.40 ^a	4.66 ^b	9.33 ^a	1.03	0.013	8.10-12.87
P, mg/dL	6.75 ^b	4.65 ^c	8.45 ^a	1.08	0.030	4.53-9.96

428 ^{a,b,c} Means with different letters in the same row differ for $p < 0.05$ (Duncan, 1955). * Merck
 429 Veterinary Manual, 2023. CTRL: control group; TRT1: antibiotic group; TRT2: group
 430 supplemented with a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 at a
 431 concentration of 5×10^9 CFU/mL
 432

Table 3. Effect of a biopreparation with *Lactiplantibacillus plantarum* CAM-6 on the yield of edible portions of the carcass of growing pigs

Item	CTRL	TRT1	TRT2	SEM	<i>p</i> -value
Carcass, kg/animal (%)	36.66 (68.84 ^a)	36.32 (64.56 ^b)	39.74 (69.90 ^a)	1.225	0.050
Loin, kg/animal (%)	5.98 (16.32 ^b)	5.69 (15.66 ^c)	7.22 (18.16 ^a)	0.721	0.031
Shoulder, kg/animal (%)	2.53 (6.90 ^{ab})	2.32 (6.38 ^b)	2.79 (7.01 ^a)	0.187	0.008
Leg, kg/animal (%)	3.70 (10.09 ^a)	3.32 (9.14 ^b)	3.81 (9.60 ^{ab})	0.264	0.010
Rib, kg/animal (%)	2.00 (5.46 ^a)	1.71 (4.72 ^b)	2.17 (5.46 ^a)	0.207	0.009
Backfat thickness, cm	2.15 ^a	2.30 ^a	1.86 ^b	0.135	0.018

^{a,b,c} Means with different letters in the same row differ at $p < 0.05$.

CTRL: control group; TRT1: antibiotic group; TRT2: group supplemented with a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 at a concentration of 5×10^9 CFU/mL.

Estimated carcass and cut weights were calculated from treatment mean final live weights (CTRL: 53.25 kg; TRT1: 56.25 kg; TRT2: 56.85 kg), using carcass yield and the corresponding edible-portion proportions. These kg/animal values are estimated treatment means, not individual measurements. Percentages are shown in parentheses; SEM and *p*-values refer to percentage/yield data.

Table 4. Effect of a biopreparation with *Lactiplantibacillus plantarum* CAM-6 on the chemical composition of the *Longissimus dorsi* muscle in growing pigs

Item	Treatments			SEM	P value
	CTRL	TRT1	TRT2		
Moisture, %	66.55	66.09	66.64	1.13	0.316
Crude protein, %	21.95	23.98	22.96	2.06	0.780
Crude fat, %	2.16 ^a	2.14 ^a	1.94 ^b	0.29	0.049
Ash, %	1.54	1.47	1.64	0.11	0.445

^{a,b} Means with different letters in the same row differ from P<0.05.

CTRL: control group; TRT1: antibiotic group; TRT2: group supplemented with a biopreparation containing *L. plantarum* CAM-6 at a concentration of 5×10^9 CFU/mL.

Table 5. Effect of dietary supplementation with a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 on cooking loss, firmness, tenderness, and pH of the Longissimus dorsi muscle in growing pigs

Item	CTRL	TRT1	TRT2	SEM	p-value
Cooking loss, %	35.82 ^b	40.36 ^a	36.77 ^b	1.29	0.045
Firmness, kg·m·s ⁻¹	3.02 ^a	2.43 ^b	2.4 ^{ab}	0.13	0.022
Tenderness, kg·s ⁻¹	7.07 ^a	5.70 ^b	6.99 ^a	0.35	0.020
pH*	5.78 ^a	5.65 ^b	5.64 ^b	0.03	0.018

^{a,b} Means with different letters in the same row differ for $p < 0.05$.

*24 h after slaughter. CTRL: control group; TRT1: antibiotic group; TRT2: group supplemented with a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 at a concentration of 5×10^9 CFU/mL.

Table 6. Effect of dietary supplementation with a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 on the color parameters (L^* , a^* , b^* , C^* , and H°) of the Longissimus dorsi muscle in growing pigs

Item	CTRL	TRT1	TRT2	SEM	<i>p</i> -value
L^*	39.53 ^b	48.28 ^a	36.71 ^b	1.14	0.010
a^*	3.92	4.70	3.24	0.49	0.074
b^*	11.01	12.07	9.93	0.58	0.068
C^*	11.70 ^{ab}	13.00 ^a	10.50 ^b	0.68	0.020
H°	70.65	68.89	72.31	1.73	0.214

^{a,b} Means with different letters in the same row differ at $p < 0.05$.

L^* : lightness; a^* : red–green color axis; b^* : yellow–blue color axis; C^* : chroma (color saturation); H° : hue angle. CTRL: control group; TRT1: antibiotic group; TRT2: group supplemented with a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 at a concentration of 5×10^9 CFU/mL.

Table 7. Effect of dietary supplementation with a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 on the sensory quality of the Longissimus dorsi muscle in growing pigs

Indicators	CTRL	TRT1	TRT2	SEM	p-value
Aroma					
Normal	82.50 ^b	82.50 ^b	95.00 ^a	3.66	0.002
Abnormal	17.50 ^a	17.50 ^a	5.00 ^b	3.66	0.002
Flavor					
Normal	72.50 ^b	90.00 ^a	90.00 ^a	5.65	0.048
Abnormal	27.50 ^a	10.00 ^b	10.00 ^b	5.65	0.048
Toughness					
Normal	45.00 ^b	47.50 ^{ab}	52.50 ^a	2.26	0.012
Hard	35.00 ^a	37.50 ^a	27.50 ^b	3.22	0.035
Very hard	12.50 ^a	5.00 ^b	5.00 ^b	2.16	0.050
Very soft	7.50 ^b	10.00 ^b	15.00 ^a	2.42	0.012
Color					
Normal	42.50 ^b	52.50 ^a	52.50 ^a	3.15	0.014
Pale	55.00 ^a	37.50 ^c	42.50 ^b	4.01	0.018
Intense	2.50 ^c	10.00 ^a	5.00 ^b	2.12	0.049

^{a,b,c} Means with different letters in the same row are different at $p < 0.05$.

Texture (toughness). CTRL: control group; TRT1: antibiotic group; TRT2: group supplemented with a biopreparation containing *Lactiplantibacillus plantarum* CAM-6 at a concentration of 5×10^9 CFU/mL.