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Research Article

## Study of the effect of bacterial preparation on the morphological and histological traits of the small intestine of broiler carcasses

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### Abstract

This experiment was carried out in the poultry field of the Department of Animal Production at the College of Agriculture at the University of Basrah for the period from 25/3/2021 to 28/4/2021, in which 450 chicks (females) of the Ross 308 strain were used at the age of one day and an average of Weighing 43 g/chick, the homogenized chicks were randomly distributed to 10 experimental treatments, 45 chicks for each treatment, and one treatment included three replicates 15 chicks/ replicate. The experimental treatments included: T1: the Negative control treatment (Basal diet without addition). T2: Positive control treatment, adding dried skim milk at a level 1 g/L of drinking water. T3, T4, and T5: adding the Manufactured Bacterial Preparation at a level (0.5, 1, and 2) g / kg of feed, respectively. T6, T7, and T8: adding the Manufactured Bacterial Preparation at a level of (0.5, 1, and 2) g/L drinking water, respectively. T9: add the Manufactured Bacterial Preparation at a level 0.5 g/kg feed, and 0.5 g/L drinking water. T10: add the Manufactured Bacterial Preparation at a level 1g/kg of feed, and 1g / L of drinking water. The results showed a significant improvement ( $P \leq 0.05$ ) in the morphological characteristics of the small intestine: the relative weight of the intestine and its relative length, as well as a significant improvement ( $P \leq 0.05$ ) in the histological characteristics of the intestine, which included the height of the villi and the depth of the crypts, in the jejunum region. In favour of the manufactured bacterial preparation treatments, depending on the level and type of addition, when compared to the control treatment.

**Keywords:** Lactic Acid Bacteria, Small Intestine, Histological Sections, Morphological Characteristics.

### Introduction

The manufactured bacterial preparation is an essential product for the safety and optimal functioning of the small intestine in poultry; As a result of its high biological efficacy, which lies in the fact that it contains seven strains of lactic acid bacteria, which were isolated from the domestic birds themselves (the beneficial natural intestinal flora), which made it possess a superior ability to bring about the property of microbial balance in the small intestine and displace harmful bacteria in a very record time (Al-Salhi, 2022). The idea of making the manufactured bacterial preparation emerged in an attempt to

find a natural practice to replace the ready-made probiotics, which many researchers contributed to using, as Karumi et al. (2012) indicated that adding 0.3% of the Iraqi probiotic does not affect weight and the relative length of the small intestine of 35-day-old broiler broilers in comparison with the control treatment. Ahmed and Manati (2015) showed that using probiotics contributes to obtaining a significant increase in the height of villi and depth of crypts compared to the control treatment in their experiment conducted on broilers. This was confirmed by Zangana and Jassim (2016). They found that using probiotics increases the villi height and crypt depth in the jejunum region in their experiment, which was carried out

to study the histological characteristics and microbial community of broilers.

Whereas Han et al. (2018) indicated no significant differences in the rate of villi height and crypt depth in the jejunal region of broilers when using *Lactobacillus Plantarum* as a probiotic containing  $10^{10}$  (cfu/g) compared to the control treatment. Mohamed et al. (2019) stated that the biostimulant enhances the body's immunity by improving histologically the layers of the small intestine, which rid the body of pathogens compared to the control treatment. Small intestine and its weight, in a 42-day broiler experiment using lactic acid bacteria as a probiotic, containing two types of *Lactobacillus plantarum*  $10^{12}$  (cfu/g) and *Lactococcus lactis*  $10^9$  (cfu/g) each ml of drinking water, and to compare with previous studies, the current research came to study the effect of adding the manufactured bacterial preparation, one gram of which contains no less than  $16 \times 10^9$  (cfu/g) with seven different local strains of lactic acid bacteria, Carriers on skim milk, in the form of fine powder (Al-Salhi, 2022), On the morphological and histological characteristics of the small intestine in broiler carcasses, materials and methods of work.

## Materials and Methods

### Experimental design

This experiment was conducted in the poultry field of the department of Animal Production at the College of Agriculture at Basrah University, from 25/3/2021 to 28/4/2021, for 35 days. 450 experimental broiler chicks, Ross 308 strain, were used in this experiment. With an age of one day and an average weight of 43 g/chick, the chicks were raised in a three-storey battery system. Each floor contains a cage with dimensions of 1.5 x 1 m<sup>2</sup>. The sexed chicks were randomly distributed over ten experimental treatments with 45 chicks. For each treatment, and one treatment included three replicates (15 chicks/ replicate), the experimental treatments were organized as follows:

- T1:** Negative Control Treatment, Basal diet only without any addition.
- T2:** Positive Control Treatment, adding powdered skim milk at a level of 1 g/L of drinking water.
- T3:** Adding manufactured bacterial preparation at a level of 0.5g/kg of feed.
- T4:** Adding manufactured bacterial preparation at a level of 1 g/kg of feed.
- T5:** Adding manufactured bacterial preparation at a level of 2 g/kg of feed.
- T6:** Adding manufactured bacterial preparation at a level 0.5 g/L of drinking water.
- T7:** Adding manufactured bacterial preparation at a level of 1 g/L of drinking water.
- T8:** Adding manufactured bacterial preparation at a level of 2 g/L of drinking water.
- T9:** Adding manufactured bacterial preparation at a level of 0.5 g/kg of feed, and 0.5 g/L of drinking water.

**T10:** Adding the prepared vegetable at a level of 1 g/kg of feed, and 1 g/L of drinking water.

### Chick management

The room temperature was regulated according to the mercury thermometer from the age of one day until the period of 35 days, using the electric heating system and air intakes, and according to the broiler breeding guide, and the 24-hour continuous lighting system was adopted throughout the breeding period while providing all the conditions for raising broilers. The water to which the different doses of the manufactured bacterial preparation were added was prepared (according to the symbols of the treatments mentioned above), as presented in inverted 6-litre plastic buckets, to facilitate the process of drinking water freely. Fodder was also provided freely (*ad libitum*), as plastic feed trays with a diameter of 38 cm were used. The birds were fed two types of rations: the starter ration from (1-21) days of age, which contained 23.20% crude protein and 2913 kcal/kg of energy as a representative feed, and a final ration from the age of (22-35) days. It also contained 19.72% crude protein and 3164 kcal/kg feed as representative energy, and Table 1 shows the chemical composition of the feed used in the experiment.

**Table 1. Chemical composition of basal diet used in the experiment and its chemical analysis**

Feed Nutrient	Starter (1-21) day	Finisher (22-35) Day
Yellow corn	42	50
Wheat	17.2	15
Soybean meal (48%)	32	24
Protein (40%)	5	5
Primex	1	1
Plant oil	0.5	3.2
Limestone	2	1.5
Salt	0.3	0.3
Total	100	100
Calculated Chemical Composition		
Crude protein %	23.2	19.72
Metabolizable energy (kcal/kg)	2913	3164
Energy-to-protein ratio	125.55	160
Crude fibre %	3.9	3.45
Calcium %	1.07	0.88
Available phosphorus %	0.48	0.34
Methionine %	0.5	0.45
Lysine%	1.2	1.02
Methionine + Cysteine %	0.87	0.68

- Protein concentrate: Produced by the Dutch Brocon Company, it contains 40% crude protein and 2107 (kcal/kg) represented energy, 5% fat, 4.20% calcium, 2.65% phosphorous, available phosphorous 4.68%, 3.70% methionine, 0.66% Cysteine, 3.85% lysine, 20.2 crude fiber, 12.4% methionine and cysteine.

• The chemical composition of the materials included in the diets was calculated according to the recommendations of the NRC(1994).

### Morphological features of the small intestine

#### The relative length of the small intestine

$$\text{Relative length of the intestine (cm/g)} = \frac{\text{length of each part of the small intestine (cm)}}{\text{Average live body weight (g)}} \times 100$$

#### The relative weight of the small intestine

Immediately after recording the relative lengths of the intestine, its parts were cleaned of some remaining materials, and each of these parts was weighed using an electric balance

$$\text{Relative weight of the parts of the intestine} = \frac{\text{Weight of each part of the small intestine (g)}}{\text{Average live body weight (g)}} \times 100$$

### Study of the histological characteristics of the small intestine

After the birds were slaughtered, their internal guts were extracted, and their intestines were separated, sections were taken from the jejunum region with a length not exceeding 2 cm; to conduct a histological study on it and know the changes that can occur in the height of the villi and the depth of the crypts, as a result of treating the birds with the manufactured bacterial preparation, which was carried out according to sequential stages.

#### Fixation

The samples were fixed using formalin at a concentration of 10%, prepared in advance, and the intestine sections were placed in it for at least 48 hours.

#### The dehydration

The samples were taken out of the fixative material. Then they were washed with running water for 15 minutes, after which the water in the tissues was gradually removed, using ascending concentrations of ethyl alcohol that had been prepared in advance, as the samples were passed in concentrations (70, 80, 90, 100) % One by one for two hours for each engagement.

#### The clearing

Use xylene; To get rid of absolute alcohol in preparation for introducing paraffin wax into the sample cells, pass the tissue

After the viscera were removed, the intestine was separated at its attachment to the gizzard. The length of the small intestine was measured using a metric scale for each of its parts (duodenum, jejunum, ileum) separately, and the relative length of the intestine was calculated relative to the live weight according to the following equation (Mobini, 2011).

sensitive to three decimal places (Kuren 572) of Turkish origin, and the proportion of each of them to the weight of the living body was calculated according to the following equation.

with xylene at least twice (at a rate of 15 minutes for each time), taking into account not to extend the time so as not to damage the sample.

#### The infiltration and the embedding

At this stage, the molten paraffin wax is permeated to the tissues and cells of the sample by passing the piece through glass containers containing pure molten wax inside an electric oven at 60 °C for 15 minutes in each container, during which the resin is permeated to all parts of the sample, after which the pieces are embedded in special moulds and poured Melted wax at 60 °C on it with the addition of coefficient symbols, then left to harden.

#### The sectioning

The wax blocks embedded in the samples were cut to obtain thin microscopic wax sectors using a rotary microtome device. Wax blocks with a thickness of 5 micrometers are accepted, and they are transferred by a soft brush and scalpel to the water bath at a temperature of 40 °C, after which they are loaded onto glass slides; To be coated with a mixture of egg albumen and glycerin to fix the tissue on the decline during dyeing.

#### The staining

Pigmentation segmentation; To show their interior features and allow for examination and study, the sectors are treated with chemical solutions that work to dye the sectors (100, 95, 90, 80, 70) percent water to saturate them, then distilled water

to remove alcohols. The sectors are stained with hematoxylin to dye the nuclei inside the sectors and then rinsed in running water to remove excess dye before being examined. A 1 percent acid alcohol solution is prepared by adding 1 ml of hydrochloric acid to 99 ml of alcohol to dilute the dye if it appears dark in the nuclei, then the sections are dyed with eosin dye (Eosin stain), as this dye stains the cytoplasm tissue in all parts of the sectors in red-pink colour, then the sectors are dyed with eosin dye (Eosin stain), as this dye stains Then it is covered with DPX adhesive and a thin slide cover until it is permanent, with one or two drops of the material placed, then the cover is tightly placed so that no air bubbles form inside the sectors, and it is placed. The dyed sectors are placed over a thermal heater to completely dry the adhesive and fix the covers. The data is recorded before the sectors are ready for examination (Al-Ratrout et al., 2009).

### Examination of tissue sections

The prepared tissue slides were examined using the German-made LEICA ICC50 HD optical microscope. All measurements were recorded using the ocular micrometer with a magnification power of 400X after it was installed on the microscope and then matched with the slide installed on the stage. The glass containing the tissue and read the measurement of the length of the villi and the depth of the crypts in units (microns) according to what Galigher and Kozoloff (1964) then multiplied the product by the value of the constant, and the result is in microns, noting that the length of the villi extends from the top of the villi to the connection of the crypt.

The crypt depth is defined as the immersion depth or distance between adjacent villi (Uni et al., 1999). The histological sections of the villi and crypts were then photographed using a digital camera integrated with an optical microscope, and the constant was calculated using the following equation:

$$\text{Constants} = \frac{\text{Ophthalmic scale} \times \text{lens power}}{\text{Oculometer}}$$

(Galigher and Kozoloff, 1964)

### Statistical analysis

The complete random design (CRD) was used to study the effect of different treatments on the studied blood parameters. The significant differences between the means were compared by Duncan's polynomial test (1955) under the significance level of 0.05. The program SPSS (2018) was used in the statistical analysis.

### Results and discussion

#### Morphological features of the small intestine

#### Effect of the use of a manufactured bacterial preparation on the relative length of the small intestine and its parts

Table 2. shows the effect of using the manufactured preparation on the relative length (%) of the small intestine and its parts (duodenum, jejunum, ileum), for broiler carcasses at 35 days of age, as a significant increase ( $P \leq 0.05$ ) in the relative length of the small intestine was observed. In favour of the treatments of the manufactured bacterial preparation (T5, and T7) compared to the control treatments and some treatments of manufactured bacterial preparation (T3, T4, T6, and T9). Also, it was noted that there were no significant differences between some groups of experimental treatments (T6, and T9) and (T1, T2, T3, and T4) on the one hand, and between (T6, T9) and (T8, and T10) on the one hand, as well as between (T8, and T10) and (T5, and T7) on the other hand, and in the relative length index of the duodenum, we did not notice any significant differences Among all the experimental treatments, as for the relative length of the jejunum, some treatments of the manufactured bacterial preparation (T5, T7, T8, and T10) were significantly ( $P \leq 0.05$ ) superior to the two control treatments (T1, and T2) as well as the other treatments of the synthetic preparation (T3, T4, T6, and T9), noting that there were no significant differences between this group and the two control treatments. While in the relative length of the ileum, the seventh treatment (T7) was separate from its predecessors from the other treatments in an independent center for moral superiority ( $P \leq 0.05$ ) over the two control treatments (T1, and T2) and some other treatments of the manufactured bacterial preparation (T3, T4, T6, and T9). While there are no significant differences between (T5, T8, and T10) and (T1, T2, T3, T4, T7, and T9) on the one hand, and between (T5, T8, and T10) and (T5) on the other, the two treatments The control (T1, and T2) did not record any significant differences in the relative length of the small intestine and its parts (Duodenum, Jejunum, Ileum) for broiler carcasses.

#### Effect of the use of a manufactured bacterial preparation on the relative weight of the small intestine and its parts

It is noted from Table 3. the effect of using the manufactured preparation on the relative weight (%) of the small intestine and its parts (duodenum, jejunum, ileum) for broiler carcasses at the age of 35 days, as it is noticed that a significant superiority ( $P \leq 0.05$ ) in the relative weight of the intestines was obtained. The minute was in favour of some of the treatments of the manufactured bacterial preparation (T5, T7, T8, and T10) over the two control treatments (T1, and T2) as well as on the other treatments of the manufactured bacterial preparation (T3, T4, T6, and T9), as these treatments did not register significant differences compared to the two treatments. Control, as for the relative weight of the duodenum, we did not notice any significant differences between all the study treatments.

**Table 2. Effect of using the manufactured bacterial preparation on the relative length (%) of the small intestine and its parts (mean ± standard error)**

Treatments	Small intestine(%)	Duodenum(%)	Jejunum (%)	Ileum(%)
T1	9.31±0.45 <sup>c</sup>	1.54±0.03	3.40±0.39 <sup>b</sup>	4.36±0.07 <sup>b</sup>
T2	9.33±0.31 <sup>c</sup>	1.54±0.05	3.40±0.18 <sup>b</sup>	4.39±0.17 <sup>b</sup>
T3	9.47±0.22 <sup>c</sup>	1.54±0.06	3.37±0.04 <sup>b</sup>	4.55±0.11 <sup>b</sup>
T4	9.71±0.20 <sup>c</sup>	1.58±0.01	3.48±0.04 <sup>b</sup>	4.65±0.15 <sup>b</sup>
T5	10.89±0.23 <sup>a</sup>	1.60±0.02	4.55±0.19 <sup>a</sup>	4.74±0.08 <sup>ab</sup>
T6	9.77±0.11 <sup>bc</sup>	1.58±0.07	3.53±0.07 <sup>b</sup>	4.65±0.23 <sup>b</sup>
T7	11.26±0.38 <sup>a</sup>	1.61±0.01	4.36±0.18 <sup>a</sup>	5.28±0.19 <sup>a</sup>
T8	10.71±0.43 <sup>ab</sup>	1.60±0.00	4.28±0.06 <sup>a</sup>	4.81±0.36 <sup>ab</sup>
T9	9.83±0.32 <sup>bc</sup>	1.58±0.05	3.56±0.28 <sup>b</sup>	4.68±0.09 <sup>b</sup>
T10	10.7±0.11 <sup>ab</sup>	1.60±0.03	4.39±0.15 <sup>a</sup>	4.71±0.12 <sup>ab</sup>
<b>Significance</b>	*	<b>N. S</b>	*	*

T1: control (negative) treatment. T2: The control (positive) treatment was the addition of dried skim milk at a level of (1)g/L drinking water. T3, T4, and T5: adding manufactured bacterial preparation at a level (0.5, 1, and 2) g/kg feed respectively. T6, T7, and T8: adding manufactured bacterial preparation at a level (0.5, 1, and 2) g/ L drinking water respectively. T9 and T10: add manufactured bacterial preparation at a level of (0.5) g/kg feed, and (0.5) g/ L drinking water. T10: add manufactured bacterial preparation at a level (1)g/kg feed, and (1)g/ L drinking water. N.S: Indicates that there are no significant differences between the averages of the treatments. \* The different letters within the same column indicate significant differences between the treatments at the 0.05 probability level.

The results did not differ in the relative importance of the jejunum, as they were utterly similar to the results of the relative weight of the small intestine in terms of the centers of the transactions in the moral differences and their superiority over the other treatments. Regarding the relative weight of the coil, some treatments of the manufactured bacterial preparation (T5, T7, T8, and T10) were significantly (P<0.05)

superior to the two control treatments, as well as to the third manufactured bacterial preparation treatment (T3). At the same time, there were no significant differences between the group of treatments of the preparation. The factory (T4, T6, and T9) and (T1, T2, T3) on one side, and between the same group (T4, T6, and T9) and (T5, T7, T8, and T10) on the other.

**Table 3. Effect of using the manufactured preparation on the relative weight (%) of the small intestine and its parts (mean ± standard error)**

Treatments	Small intestine (%)	Duodenum (%)	Jejunum (%)	Ileum (%)
T1	3.84±0.02 <sup>b</sup>	0.82±0.02	1.22±0.01 <sup>b</sup>	1.80±0.05 <sup>b</sup>
T2	3.88±0.06 <sup>b</sup>	0.83±0.03	1.24±0.02 <sup>b</sup>	1.81±0.03 <sup>b</sup>
T3	3.96±0.12 <sup>b</sup>	0.84±0.02	1.30±0.01 <sup>b</sup>	1.82±0.08 <sup>b</sup>
T4	4.11±0.10 <sup>b</sup>	0.86±0.03	1.34±0.04 <sup>b</sup>	1.94±0.02 <sup>ab</sup>
T5	4.73±0.11 <sup>a</sup>	0.95±0.02	1.63±0.04 <sup>a</sup>	2.15±0.09 <sup>a</sup>
T6	4.20±0.08 <sup>b</sup>	0.87±0.04	1.36±0.04 <sup>b</sup>	1.97±0.01 <sup>ab</sup>
T7	4.72±0.20 <sup>a</sup>	0.92±0.04	1.64±0.08 <sup>a</sup>	2.16±0.09 <sup>a</sup>
T8	4.75±0.19 <sup>a</sup>	0.90±0.05	1.71±0.09 <sup>a</sup>	2.14±0.09 <sup>a</sup>
T9	4.25±0.10 <sup>b</sup>	0.86±0.02	1.39±0.07 <sup>b</sup>	2.00±0.05 <sup>ab</sup>
T10	4.63±0.13 <sup>a</sup>	0.92±0.03	1.58±0.05 <sup>a</sup>	2.13±0.10 <sup>a</sup>
<b>Significance</b>	*	<b>N. S</b>	*	*

T1: control (negative) treatment. T2: The control (positive) treatment was the addition of dried skim milk at a level of (1)g/L drinking water. T3, T4, and T5: adding manufactured bacterial preparation at a level (0.5, 1, and 2) g/kg feed respectively. T6, T7, and T8: adding manufactured bacterial preparation at a level (0.5, 1, and 2) g/ L drinking water respectively. T9 and T10: add manufactured bacterial preparation at a level of (0.5) g/kg feed, and (0.5) g/ L drinking water. T10: add manufactured bacterial preparation at a level of 1 g/kg feed, and (1)g/ L drinking water. N.S: Indicates that there are no significant differences between the averages of the treatments. \* The different letters within the same column indicate significant differences between the treatments at the 0.05 probability level.

The reason for obtaining a significant increase in the weight and relative length of the small intestine and its parts, which

include: the jejunum and the ileum, is attributed to the role of lactic acid bacteria present in the manufactured bacterial

preparation, in ensuring intestinal safety, by lowering the pH and secreting a wide range of metabolites, which provide an unsuitable environment for the growth and activity of pathogenic bacteria, which contributes to their displacement outside the digestive canal, and thus will leave an opportunity for lactic acid bacteria to settle in the inner layer lining the digestive canal, after closing the receptors in front of pathogenic bacteria that have been displaced outside the body, and metabolic products play an important role in improving metabolism. This may ultimately affect the integrity of the internal organs, such as the intestines and its parts (Al-Salhi, 2022).

This result did not agree with what Karumi et al. (2012) found that adding 0.3% of the Iraqi probiotic does not affect the weight and relative length of the small intestine of 35-day-old broiler broilers compared to the control treatment. The findings contradicted those of Deraz et al. (2019). They found no significant differences in the relative weight of intestine length or small intestine weight in 42-day-bred broilers given lactic acid bacteria as a probiotic in drinking water.

### Histological characteristics of the small intestine

#### Effect of using a manufactured bacterial preparation on the rate of villi height and crypt depth

Table 4. shows the effect of manufactured bacterial preparation on the average villi height and crypt depth ( $\mu\text{m}$ ) in the jejunal part of the small intestine of broilers at the age of 35 days. It is also noted that the treatments of the preparation were superior to each other, as treatments (T7, T8, and T10) were significantly ( $P \leq 0.05$ ) fine to the two treatments (T3, and T4), and there were no significant differences between some of the treatments of the manufactured bacterial preparation (T3, and T4) on the one hand, and between (T4, T5, T6, and T9) on the other hand, as well as between (T5, T6, and T9) and (T7, T8, and T10) on the other hand. The treatments of manufactured bacterial preparation (T5, T6, T7, T8, T9, T10) were significant ( $P \leq 0.05$ ) on the two control treatments (T1, and T2). At the same time, there were no significant differences between (T3, T2, and T1) on the one hand and between (T3, and T4) on the other hand.

The moral improvement that occurred in the length of the villi and the depth of the crypts in the jejunum region in the small intestine of broilers at the age of 35 days occurred due to the improvement of the intestinal conditions, after achieving the microbial balance, due to the content of the bacterial preparation made from different strains of lactic acid bacteria. They act synergistically to dislodge pathological bacteria, which obstruct the work of the digestive system; Because they live or compete with the digestive system of the host (the bird) for nutrients that are released during the metabolism process, excluding them from outside the body, allows the host to increase the benefit from the absorption of nutrients. As a result, the rate of the length of the villi and the depth of the crypts increases, and the increase in the length of the villi

contributes to narrowing the diameter of the alimentary canal, which causes a slow passage of the food mass in the jejunal and ileum regions, and this will also contribute to increasing the utilization of nutrients and improving the digestion coefficient of broilers (Al-Salhi, 2022).

**Table 4. The effect of using the manufactured bacterial preparation on the average villi height and crypt depth (micrometers) in the jejunum region (mean  $\pm$  standard error)**

Treatments	Villus Length( $\mu\text{m}$ )	Crypts depth( $\mu\text{m}$ )
T1	529.64 $\pm$ 16.75 <sup>d</sup>	86.64 $\pm$ 3.44 <sup>c</sup>
T2	532.93 $\pm$ 17.90 <sup>d</sup>	87.98 $\pm$ 3.70 <sup>c</sup>
T3	700.19 $\pm$ 23.07 <sup>c</sup>	102.98 $\pm$ 3.15 <sup>bc</sup>
T4	733.52 $\pm$ 17.62 <sup>bc</sup>	112.94 $\pm$ 3.13 <sup>ab</sup>
T5	789.82 $\pm$ 20.53 <sup>ab</sup>	130.16 $\pm$ 2.51 <sup>a</sup>
T6	773.49 $\pm$ 17.60 <sup>ab</sup>	129.07 $\pm$ 5.53 <sup>a</sup>
T7	807.52 $\pm$ 19.99 <sup>a</sup>	131.85 $\pm$ 6.36 <sup>a</sup>
T8	814.14 $\pm$ 18.74 <sup>a</sup>	132.56 $\pm$ 3.72 <sup>a</sup>
T9	780.18 $\pm$ 15.22 <sup>ab</sup>	131.41 $\pm$ 5.78 <sup>a</sup>
T10	801.13 $\pm$ 25.79 <sup>a</sup>	130.18 $\pm$ 2.30 <sup>a</sup>
Significance	*	*

T1: control (negative) treatment. T2: The control (positive) treatment was the addition of dried skim milk at a level of 1 g/L drinking water. T3, T4, and T5: adding manufactured bacterial preparation at a level (0.5, 1, and 2) g/kg feed respectively. T6, T7, and T8: adding manufactured bacterial preparation at a level (0.5, 1, and 2) g/ L drinking water respectively. T9 and T10: add manufactured bacterial preparation at a level of 0.5 g/kg feed, and 0.5 g/ L drinking water. T10: add manufactured bacterial preparation at a level 1 g/kg feed, and 1 g/L drinking water. N.S: Indicates that there are no significant differences between the averages of the treatments. \* The different letters within the same column indicate significant differences between the treatments at the 0.05 probability level.

This result was consistent with what was observed by Ahmed and Manati (2015) that the use of probiotics contributes to obtaining a significant increase in the height of villi and depth of crypts compared to the control treatment.

It also agreed with the results of Zangana and Jassim (2016) that the use of probiotics leads to a significant increase in the rate of villi height and the depth of crypts in the jejunum region in their experiment conducted to study the histological characteristics and microbial community of broilers. It did not agree with what was found by Han (2018) in the absence of significant differences in the rate of villi height and crypt depth in the jejunum region when using *Lactobacillus Plantarum* as a probiotic compared to the control treatment. It also agreed with what was observed by Mohamed et al. (2019) in that the probiotic enhances the body's immunity by improving the layers of the small intestine histologically, ridding the body of pathogens compared to the control treatment.

## Conclusions

We conclude from this study that there is a significant improvement ( $P \leq 0.05$ ) in the morphological characteristics of the intestine, such as the relative weight and relative length of the intestine, as well as a significant improvement in the histological characteristics of the intestine, which included the height of the villi and the depth of crypts, in the jejunum region, in favour of the treatments of the manufactured bacterial preparation, depending on the level of addition.

## Conflict of Interest

The author hereby declares no conflict of interest.

## Consent for publication

The author declares that the work has consent for publication.

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## Ethical Considerations

The study was approved by the institutional ethical Committee.

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