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PERFORMANCE AND MORPH PHYSIOLOGICAL CHARACTERISTICS OF THE DIGESTIVE TRACT ON RABBITS FED WITH HYDROPONIC GREEN BARLEY FODDER AND SWISS CHARD AS COMPLEMENT DIETS

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Abstract: The high nutritional content of rabbit meat is attributed to its proteins and fats. Because of the vitamins, minerals, and micronutrients, it also has a high biological value. By giving the rabbits pellets (Winner Rabbit concentrated food) along with hay, the nutritional content can be increased. The purpose of this study was to assess the effect son rabbit performance and organ measures of substituting 30, 50, and 100% of the food pellets for hydroponically grown Swiss chard or green barley fodder (HGBF) without reducing the animal's productivity during the fattening phase. A total of fifty-six thirty-day-old rabbits were fed seven different dietsfor 42 days. At the conclusion of the feeding period, the performance of the rabbits and several organs was measured. The ultimate weight of the rabbits was unaffected by substituting 50% concentrated chard or hydroponic green barley fodder (HGBF). Consequently, it was determined that one potential alternative to lower feeding costs in meat production systems would be to reduce concentrated chard or HGBF by 50% in rabbits during the fatting stage.
Keywords: Barley hydroponic green fodder, chard, rabbits.

INTRODUCTION

The variety of meat available in the market is increasing. Rabbit meat has a high nutritional value compared with the other types of meat (Cullere et al. 2016). This animal have the advantages of being small animals,which makes them cheap, easy to breed and handle in small spaces, their reproductive cycle is short, and their genes have been homogenized and has low inter-individualvariability (Biaginietal. 2016). The main components of rabbit meat are water, proteins and lipids, also, has high levels of essential amino acids and micronutrients such as vitamins and minerals. Additionally,

it is low in uric acid and purines, and it is low infat. However, according to many studies, the carcass quality can be affected depending on the feeding of therabbits (Zepeda-Bastida et al. 2019).Moreover, rabbits, being non-ruminant herbivores, the cecotrophy allowt hem to include a wide variety of foods in their diet and post-gastric digestion is highly influenced by the rich intestinal microbial population (Molina et al. 2015). By mean of the cecotrophy, rabbits have a second digestion with the consumption of their soft faeces (Schulze 2015), besides, this mechanism increase the.

The main cost of rabbit meat production is relating with the commercial feed pellets that arise in 75% of the total cost production, so the search for complementary options to reduce it is essential today. The objective ofthis study was to evaluate the effect of replacing 30, 50 and 100% of pellets food rabbit for Hydroponic Green Barley Fodder (HGBF) or Swiss chard on the performance and some organs measurements of the rabbits,withoutd ecrease the animal's yield on the fatting period.

METHODS AND MATERIALS

ANIMAL RAW MATERIAL

The assessment was performed at IDGREEN farm. The protocol was reviewed and approved by the Engineering Science Faculty's Bioethics Committee (authorization: 9499-FI-2017) of the Autonomous University of Queretaro. The handling of the experimental animals was carried out conforming to the Mexican Official Norm 'NOM-062-ZOO-1999' guide lines (SAGARPA 2001) and the International Guiding Principles for Biomedical Research Involving Animals (CIOMS/ICLAS 2012). In this study were used 56 New Zealand rabbits of both sex with an age of 30 days old. Rabbits with an average body weight (BW) of 425 ± 0.65 g were used. The experiment was implemented in a randomized blocks design. There were three research units pe rtreatment and three rabbits in each unit. The standard conditions were, on the case of the temperature, between 19 and 27°C, relative air humidity was maintained at 40–65%, the room was intensively ventilated, and the photoperiod was 12-h lighting and 12-h darkness. In addition, the animals were fed with seven different diets during 42 days. The treatments were T1: 100 % pellets, T2: 50% pellets + Swiss chard, T3: 50% pellets + HGBF, T4: 30% pellets + Swisschard, T5: 30% pellets + HGBT, T6: Swisschard, T7: HGBF. Rabbits had *ad libitum* access to their nipple drinkers; while the pellets, HGBT and chard were supplied according to the experiment. On the day 42 of the experiment, the rabbits were slaughtered (Gómez Sotoetal. 2018).

The laboratory analyses were carried out in the Animal Nutrition Laboratory of the Faculty of Natural Sciences. Rabbits were slaughtered and the skin was released. Then the organs were collected. The stomach, jejunum, ileum, cecum, and colon were dissected and emptied, and the pH of their contents was measured with a potentiometer (Model PH211, Hanna Instruments®). The hot carcass was weigh with a precise balance, then the carcass werestorage at 4° C and after 24 hours the cold carcass were weighted. To determine the weight of each part, the duodenum, jejunum, ileum and cecum sections were collected, washed with a saline solution, weighed and kept in a 10% neutral formalin solution for further analyses (Gómez Soto et al. 2018). Data were analysed as a randomized complete block design. Data were subjected to analysis of variance (ANOVA) and Tukey´s least significant difference test ($\alpha = 0.05$) using the Statgraphics® Centurion XVI statistical software (StatPoint Technologies Inc., Bedford, MA, USA, 2010).

RESULTS AND DISCUSSION

The Grafic 1, panel A shows the live weight, were no differences between the treatments 1, 2, 3, 4 and 5. Being the treatments 6 and 7 the worst ones. Molina et al. (2015) did not find significant differences between treatments with *Amaranthus dubius* Mart. ex Thell; these changes in the feed intake could be modified with the weather and the balance in the fibre content in Swiss chard and HGBF (Molinaet al. 2015

On the case of the hot carcass weight, has not significative difference the treatment 100% pellets in comparison with 50% pellets + Swiss chard or HGBF and 50% pellets + HGBF. The same result was obtained for the cold carcass weight. Cardinali et al. (2015) found significant different in carcass weight after 50 days at 0.2% oregano extract and pellets in rabbits.

The Grafic 2 shows, that the colon empty weight had not difference between the treatments 1, 2, 3 y 5; being the treatments 4, 6 and 7 the worst ones; the same results were obtained on the case of the jejunum empty weight . On the case of the blind length, were not significative differences between the treatments 1, 2, 3, 4, 5 and 6, the treatment 7 was the worst one. Similar results were obtained with the stomach empty weight. Several studies found that the high fibre diets provoked a significant extension of the gastrointestinal tract, common diets mixed with 200 g/kg of soybean hulls (Shang et al. 2017). Cardinali et al. (2015) mixed oregano and rosemary extract with standard diet in rabbit´s food. The antimicrobial effect of oregano extract controlled pathogens in the gastrointestinal microbiota giving higher grown performance (Cardinali et al. 2015).

In the graphic 3. The liver weight didn't shows significative differences between the treatments 1, 2, 3, 4, and 5. On the case of the case of the relative stomach weight, the treatment 7 (HGBF) shown significative differences with the rest of the others treatments. Furthermore, the jejunum relative weight didn't shown differences between the treatments, just between the treatment 7 and 1. The importance of the digestive system of the rabbit differs by the cecum compared to other species. Likewise, the relative weights of stomach and caecum were lower at the maximum dose of soybean hulls than the 100% pellets (Shangetal. 2017).

The blind relative weight was significant different with the treatment HGBF followed by the treatment of Swiss chard. Eiben et al. (2011) had significant difference in the full gastrointestinal tract weight with the control diet supplemented with 60 mg/kg synthetic vitamin E in rabbits (Eiben et al. 2011).

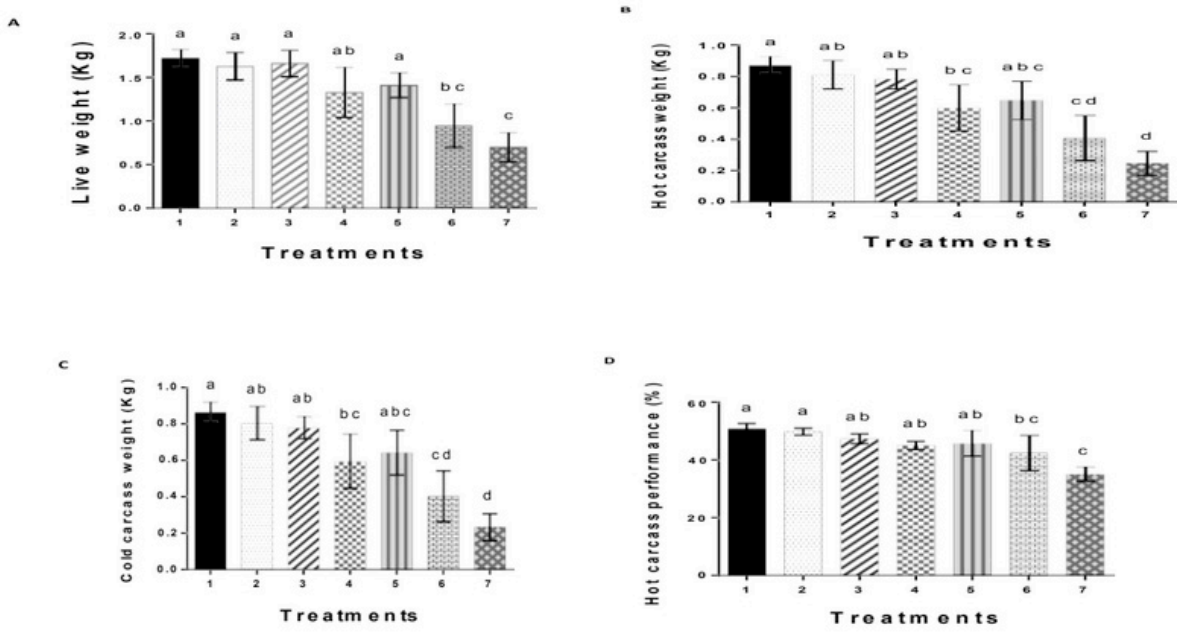
In this study, on the colon relative weight, also the treatment HGBF was the best, although were not significative differences between it and the treatments 2, 3, 5 and 6. Moreover, the relative weight of colonwere significantly greater consuming a high-fibre diet, several studies found that the high fibre diets provoked a significant extension of thegastrointestinal tract (Shangetal. 2017).

The treatment HGBF was significantly different in the variable relative gallbladder weight. Shanti et al. (2017) replaced pellets with the 40 and 60 % of HGBF in the diet had a significant increment in gall bladder weight, aversely others organs were not affected by the inclusion of HGBF (Shanti et al. 2017).

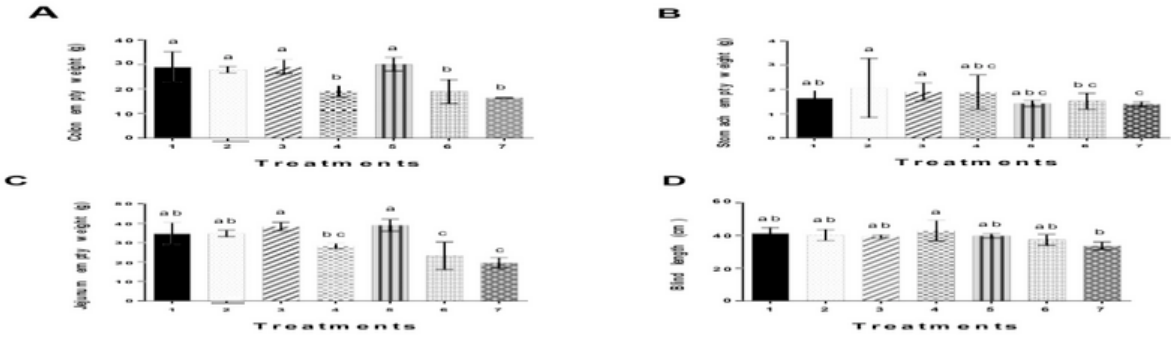
CONCLUSIONS

Our results confirmed that it is possible the reduction of 50% in pellets and replace it with Swiss chard or HGBF. This reduction had important advantages, like the reduction in the pellets cost, the Swiss chard and HGBF are cheaper and easier to get than the pellets, for farmers. In addition, including Swiss chard and HGBF in the diet have positive effects on

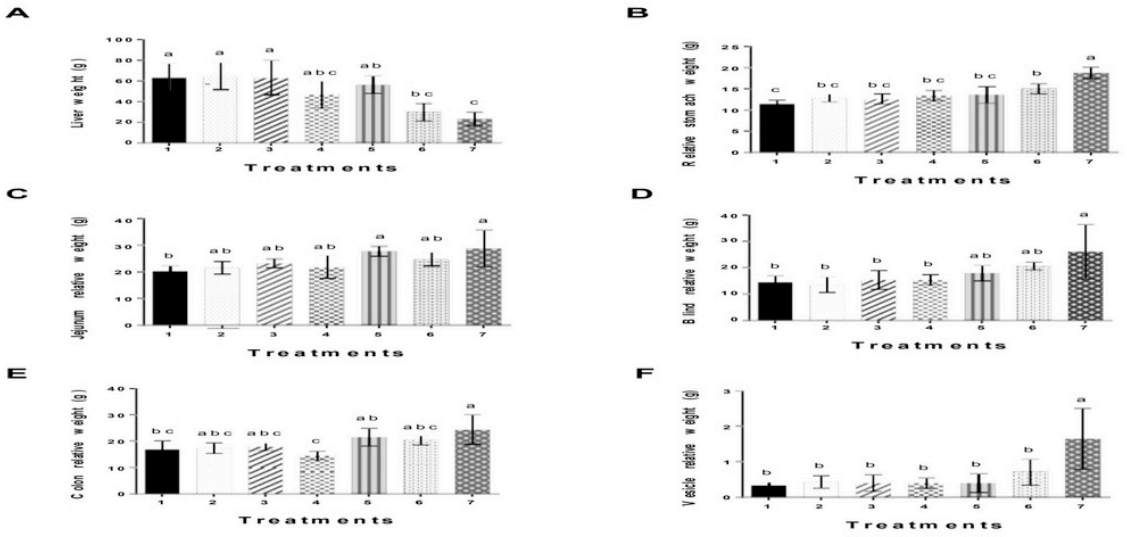
performance and morphological aspects in rabbits. Contrary, diets 100%-based in fodder diminished the health and performance of the animals, although increase the weight of some organs



Grafic 1. A) Live weight (Kg), B) Hot carcass weight (Kg), C) Cold carcass weight (Kg) and D) Hot Carcass performance (%). T_1: 100% pellets, T_2: 50% pellets + Swiss chard, T_3: 50% pellets + HGBF, T_4: 30% pellets + Swiss chard, T_5: 30% pellets + HGBT, T_6: Swiss chard, T_7: HGBF. All treatments were ad libitum. HGBF (Hydroponic Green Barley Fodder). Different letters indicate significant difference according to ANOVA and Tukey test (α= 0.05).



Grafic 2. A) Colon empty weight (g), B) Stomach empty weight (g), C) Jejunum empty weight (g), D) Blind length (cm). T_1: 100% pellets, T_2: 50% pellets + Swiss chard, T_3: 50% pellets + HGBF, T_4: 30% pellets + Swisschard, T_5: 30% pellets + HGBT, T_6: Swisschard, T_7: HGBF. All treatments were ad libitum. HGBF (Hydroponic Green Barley Fodder). Different letters indicate significant difference according to ANOVA and Tukeytest (α= 0.05).



Grafic 3. A) Liver weight (Kg), B) Relative stomach weight (Kg), C) Jejunum relative weight, D) Blind relative weight, E) Colon relative weight, F) Vesicle relative weight (Kg). T1: 100 % pellets, T2: 50% pellets + Swiss chard, T3: 50% pellets + HGBF, T4: 30% pellets + Swiss chard, T5: 30% pellets + HGBT, T6: Swiss chard, T7: HGBF. All treatments were ad libitum. HGBF (Hydroponic Green Barley Fodder). Different letters indicate significant difference according to ANOVA and Tukey test (α= 0.05).

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