Scientific Paper

Effect of the inclusion of a biopreparation of efficient microorganisms (IHplus®) in diets of fattening pigs

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ABSTRACT: A study was conducted under production conditions in order to determine the effect of a biopreparation of efficient microorganisms (IHplus®) on the live weight (LW), mean daily gain (MDG) and feed conversion (FC), in fattening crossbred pigs. To establish the optimum quantity of inclusion of the biopreparation, three doses were evaluated: 40, 80 and 120 mL/pig/day, through a completely randomized design. The diets were uniform and included concentrate feed B, Nuprovim, enriched cassava silage, molasses B and ground rice hulls. A total of 144 animals were used with an average initial LW of 27,0 ± 0,5 kg and 76 days of age, at a rate of 36 pigs per treatment, and the experimental period was 132 days. The pigs that did not consume IHplus® showed the worst productive indicators (90,4 ± 1,6 kg; 0,478 ± 0,011 kg and 4,06 ± 0,01 kg for LW, MDG and FC, respectively), while the 40-mL dose contributed the best results (98,3 kg; 0,583 kg and 3,64 kg), with an increase of 15,4 % in the gain. It is concluded that the inclusion of IHplus® promotes a higher income, and although the zootechnical indicators are far from the ones considered optimal, the fact that they are achieved with the feedstuffs available in the country allows to suggest that this biopreparation is included to evaluate its efficiency in pig fattening. It is recommended as optimum dose that of 40 mL/pig/day of IHplus®, as well as the diffusion of its use in this pig category.

Keywords: animal feeding, gains, body weight

INTRODUCTION

In Cuba, pork constitutes one of the most important lines of family economy, as it is a valuable food source. However, one of the main limitations to increase its production is the feed deficit and the low weight gains that are obtained, for which every action aimed at optimizing the utilization of the available resources and decreasing the rearing costs and time is extremely important.

That is why studies have been promoted in order to include, in the diets, products capable of improving the feed conversion values, as in the case of probiotics; they are highly costly, except when they are nationally produced (Álvarez, 2009).

García *et al*. (2014) stated, as limitation, the little diffusion of the advantages of these products when being included in the rearing systems of the country.

At the Pastures and Forages Research Station (EEPF) Indio Hatuey, Blanco *et al*. (2012) developed a bioproduct based on efficient microorganisms, called IHplus®, which proved to be effective in the improvement of the animal response when it was included as digestion activator in the diets, of ruminants as well as monogastric animals. Nevertheless, in the case of fattening pigs the optimum dose to be used is unknown, aspect which constituted the objective of this research.

MATERIALS AND METHODS

The evaluation was conducted in the Enhanced Cooperative of Credits and Services (CCSF for its initials in Spanish) Pedro Julio Sotolongo, from the Calimete municipality (Matanzas province, Cuba), in an intensive fattening system which uses the "all full, all empty" technology. The experimental period comprised from February 17 to June 30, 2015 (132 days).

In the study 144 crossbred pigs (Yorkland mother and CC21 sire) were used, belonging to the fattening category, with 76 days of age. Each treatment was constituted by 36 marked pigs. They were distributed in a completely randomized design, in the following treatments:

- Control: without inclusion of IHplus® in the diet.
- Inclusion of 40 mL of biopreparation/pig/day.
- Inclusion of 80 mL of biopreparation/pig/day.

- Inclusion of 120 mL of biopreparation/pig/day.

It was adopted, as criterion, to incorporate the biopreparation continuously in the diet (Brizuela, 2003). To guarantee that the pigs consumed the foreseen doses, every day the IHplus® –acquired at the EEPF Indio Hatuey and elaborated according to the methodology recommended by Blanco *et al*. (2009)– was mixed homogeneously along with the solid components of the diets and supplied in the first feed offer, in the morning.

The animals were weighed in the early morning hours, before the feed supply, and the individual growth of each animal was monitored at three moments of the research: at the beginning, after 57 days and when the pigs were delivered for slaughter. For such purpose a platform scale, with accuracy of ± 0,1 kg, was used.

The water was supplied at will, through nipple drinkers; and also a good veterinary status of the pig herd was guaranteed, by deworming at the beginning of the evaluation, sanitary control in the access of people from outside the farm and the daily cleaning of the sheds.

The feedstuffs used in the diets were: concentrate feed B, Nuprovim, enriched cassava silage, molasses B and ground rice hull; which were combined to cover the nutritional requirements of the animals, according to their availability, the nutritional criteria of the feeding advisor of the municipality and the live weight of the pigs. They were distributed on linear troughs, three times per day.

The diets were homogeneous in quantity and quality for all the treatments, with adjustment in the intake each week (table 1). The bromatological composition of the feedstuffs (table 2) was determined in the laboratory of the agroindustrial complex Jesús Rabí (Matanzas province), according to the standard procedures of the AOAC (1990).

The ground rice hull was used as satiety-inducing factor, to regulate the intake by dominance among the pigs and to achieve that the conventional feedstuffs were ingested gradually in time.

The enriched cassava silage was acquired from a processing plant established in the agroindustrial complex Jesús Rabí, as part of the agreement of feed supply established between the farmer and the Pig Production Group of the Ministry of Agriculture (GRUPOR), and its composition was: 40 % ground cassava, 20 % molasses B, 10 % vinasse and 10 % *Saccharomyces cerevisiae* cream.

These feedstuffs were mixed and stored in fermentation tanks, during seven days under anaerobic conditions, according to the procedures established by Almaguel *et al*. (2010), and afterwards they were distributed to the animals.

The dry matter intake, the increase of live weight (LW), mean daily gain (MDG) and feed

Table 1. Intake of the diets during the experimental period.

Day	Intake (kg DM/pig/day)							
	Concentrate feed	Enriched silage	Molasses B	Total	Day	Concentrate feed	Enriched silage	Total
7	1,13*			1,13	75	1,89***	0,25	2,14
14	1,22*			1,22	82	1,92***	0,25	2,17
21	1,31**	0,08		1,39	89	1,95***	0,25	2,20
28	1,40**	0,12		1,52	96	1,98***	0,25	2,23
35	1,49**	0,15		1,64	103	2,01***	0,25	2,26
42	1,58**	0,21	0,147	1,93	110	2,04***	0,25	2,29
49	1,67**	0,25	0,294	2,21	117	2,07***	0,25	2,32
56	1,80**	0,25	0,353	2,40	124	2,10***	0,25	2,35
61	1,83***	0,25		2,08	132	2,13***	0,25	2,38
68	1,86***	0,25		2,11				
Total intake of DM/pig during the period (kg)								265,89

Proportions of ground rice hull and conventional feedstuffs during the evaluation: *15 kg of ground rice hull + 30 kg of concentrate feed B; ** 75 kg of ground rice hull + 60 kg of Nuprovim; *** 40 kg of ground rice hull + 70 kg of Nuprovim.

Table 2. Bromatological composition of the feedstuffs.

Indicator	Concentrate feed B	Enriched silage	Nuprovim	Molasses B	Rice hull
DM (%)	85,60	26,81	92,00	78,30	94,30
CP (%)	17,70	7,00	43,62	3,70	2,90
CF (%)	5,30	2,92	9,09	0	49,00
Ca (%)	0,60	1,58		1,40	1,10
P (%)	0,29	0,25		0,10	0,10
pH		3,76			
ME (Mcal/kg DM)	2,93	2,80		3,44	0

conversion (FC) were determined according to the procedures proposed by Andrial (2002).

In the case of the economic considerations, the content of the Resolution 218 for the purchase and sale prices of live pigs (Grupo de Producción Porcina, 2014) and the existing prices of the supplied feedstuffs, according to the Resolution 12/13 for pig production contracts (Grupo de Producción Porcina, 2013), were taken into consideration.

The results were analyzed by a simple classification ANOVA, through the statistical package SPSS® version 15 for Windows®. Duncan's (1955) comparison test was used for $p < 0,05$.

RESULTS AND DISCUSSION

When the objective of an evaluation is to prove the effectiveness of a biological additive, it should be conducted through designs which take into consideration the most usual variation factors, or the animals should under the same feeding and management conditions, as in the case of the procedure adopted in this study (De Mercado *et al*., 2013).

The weighing indicated two important events (table 3): the pigs of the control treatment showed the lowest LW, MDG and the least efficient FC, with regards to the ones that received IHplus®; and the lowest dose was the one which contributed the best results, with significant statistical differences.

These results coincide with the report by Santomá (2001) about the use of probiotics in concentrate feeds for piglets, who stated that the best productive results are reached only when the appropriate dose is used.

The MDGs of the first stage, until 55 days, were numerically lower than the ones obtained at the end of the evaluation period; while the best FC values were found in this intermediate measurement, except in the control group.

These results might be related to the fact that pigs with a live weight lower than 50 kg do not regulate their needs well through intake, and when the diets are low in energy components, they do not ingest the necessary quantities of feed which would allow them to improve the gain; however, being under full growth their FC is more favorable (De la Llata *et al*., 2001).

With the advance of age and the weight increase of the pigs (second stage), the MDGs tended to increase,

Table 3. Effect of IHplus® on the live weight, mean daily gain and feed conversion of fattening pigs.

IHplus® (mL)	Initial	Until 55 days			At the end of fattening (132 days)		
	LW (kg)	LW (kg)	MDG (kg/a/d)	Conversion (kg DM/kg LW)	LW (kg)	MDG (kg/a/d)	Conversion (kg DM/kg LW)
0	26,8	48,8^{c}	0,400^{c}	4,17^{a}	90.4^{c}	0,478^{c}	4,06^{a}
40	26,6	56,5^{a}	0,544^{a}	3,07^{c}	98,3^{a}	0,583^{a}	3,64^{c}
80	27,3	53,3^{b}	0,473^{b}	3,53^{b}	96,0^{ab}	0,516^{b}	3,89^{b}
120	27,1	53,5^{b}	0,482^{b}	3,46^{b}	94,9^{b}	0,505^{b}	3,92^{b}
SE (±)	0,5	1,2	0,019	0,15	1,6	0,011	0,01
Signif.	n. s.	0,001	0,001	0,001	0,01	0,01	0,01

a, b, c valores con superíndices no comunes difieren a $p < 0,05$ (Duncan, 1955)

although the maintenance needs were higher, the body growth became slower, which allowed the weight to increase at the expense of body fat deposition (Urra, 2015).

Although the values differed from the ones established for commercial enterprises: MDG of 0,840 kg and FC of 2,30 (Anon, 2015), it is important to repeat that the results of this study were obtained from non-conventional diets used by private farmers, which are elaborated with the available feedstuffs, and that the inclusion of IHplus® favored the MDG and FC. This reaffirmed the beneficial nutritional effect of this bioproduct and showed the importance of its use for the development of pig fattening.

Economic considerations

Of all the zootechnical indicators, the FC is the most important because it shows the efficiency with which the feedstuffs are transformed into meat, and in the nutritional field it is one of the most integral ones because it allows the farmer to know how the diet was utilized and, along with the cost and the sale price, it is a key element in the profitability of pig production systems (Infopork, 2014).

From the incurred expenses during the experimental period, 76,7 % corresponded to feeding, 22,8 % to salary payment and 0,5 % to other expenses, percentages that ratify the importance of introducing alternatives aimed at achieving a better utilization of feedstuffs (table 4).

As the MDG and growth rate were higher with the use of the biopreparation, this allowed to reduce the fattening cycle, which is equivalent to fattening more pigs in the same time interval and to increase the profitability of the exploitation (Urra, 2015). In this sense, the incomes per pig were higher with the use of IHplus®, and in particular with the dose of 40 mL, with which an increase of 15,4 % in the gain was obtained, with regards to the control treatment (table 5). The income obtained with the pigs which weighed more than 60 kg of live weight should be emphasized, because it is established that their live kilogram is worth 27,50 CUP, while those live animals with a weight lower than 60 kg are worth only 13,71 CUP (GRUPOR, 2014).

It is concluded that the dose of 40 mL of IHplus® per pig per day induced the best zootechnical indicators and allowed to fatten more pigs in the same time interval, because of which the farmer increased his/her profits. For such reason, it is recommended to promote the use of this dose of IHplus® in the diet of the pig fattening category.

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Table 4. Expenses during the evaluation.

Feedstuff	Cost/t (CUP)	Cost/L (CUP)	Quantity consumed (t)	Cost (CUP)
Concentrate feed B	657,67		1,80	1 183,81
Nuprovim	890,27		20,10	17 894,43
Silage	794,45		11,70	9 295,07
Molasses B	370,00		1,20	444,00
Ground citrus hull	201,00		15,50	3 115,50
IHplus®		1,5	1 150,00	1 725,00
Subtotal			33 657,81	
Salary			10 026,20	
Medicaments			200,00	
Total			43 884,01	

Table 5. Evaluation of the expenses and gross incomes per pig (CUP).

Expense/income	Cost /kg (CUP)	Treatment			
		Control	40 mL	80 mL	120 mL
		Feeding expense/pig			
		292,77	299,81	303,33	308,61
		Income for sale			
Up to 60 kg	13,71	822,60	822,60	22,60	822,60
> 60 kg	27,50	836,00	1 053,25	900,00	943,25
Total		1 658,60	1 875,85	1 812,60	1 765,85
Gross profit		1 365,83	1 576,09	1 509,27	1 457,24
Increase (%)			15,4	10,5	6,7

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