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Nutritional Management of Prefattening and Fattening Stages ot an Integrated Swine Farm

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ABSTRACT

The aim of this paper is to assess economic and biologic feasibility of different feed categories in swine pre-fattening and fattening stages. Equally important is to quantify the contribution of nutrients, digestible energy, and crude proteins based on conventional raw materials (corn and soybean), as well as non-conventional ones (parted rice, fat and sunflower meal). A composition analysis was made, and rations for pigs were simulated in the above-mentioned stages. According to the standard supplies, the protein levels found in the commercial feed type were either excessive or deficient at times in relation to animal requirements. The costs of production were subsequently increased, and nutritional unbalances were observed, making feed rations costlier than the feeds made for the stages under the study, using non-conventional raw materials.

Key words: *feed, prefattening, fattening stages, raw materials, simulation, economic feasibility*

INTRODUCTION

Countries with high production of pork generate huge amounts of swine feeds, particularly grains and soybean. Pork production in Cuba should not rely on grain imports, though. In order to increase production and make it sustainable, the portfolio of national feedstuffs must be broadened in the years to come (Martínez, 2005).

Cost effectiveness of intensive productions will depend on improvement of production indexes through intensification, using low cost systems; and low cost feed supplies (Bauzá, 2007).

The traditional corn-soybean diet has been successfully used by the swine industry in the United States for over 50 years. Due to recent increases in corn and soybean costs, the search for new alternatives to traditional ingredients is an imperative. Accordingly, the challenge for dieticians is to identify which combination is more economical to meet nutritional needs without causing yield decreases (Stein, 2011).

Another point to consider is that the technology used in many cases responds to readiness of livestock handling. In that sense, Torrallardona and Soler (2003) note that the need to make constant changes in feed composition to adjust to the needs of certain genotypes, also creates an extra logistics problem, for which there are a few solutions whose suitability will depend on each particular situation.

Pomar (1999) estimated that the more feed types used, the better they will be adapted to animal demands. Besides, excess nutrient inclusion will be minimized, and environmental pollution will decrease in such a way that depending on the additional phases, nitrogen emissions from fattening pigs (100 kg) may be reduced between 20 and 42%, in relation to the double phase standard nutrition.

A follow up and analysis study of productive and economic results from applying different concentrations in production (Echenique, 2003), revealed that small-scale systems in the facilities that use alternative feeds show high cost effectiveness, with less troubles during crises, despite their low production yields.

However, it is important to compare alternative feeds to traditional ones, when evaluating the alternative sources, because the perception is usually placed on replacing one for another, based on specialized production (Penz, 2003, cited by Lon and Díaz, 2007). However, the nutritional level and nutrient contribution in the ration must respond to the expected production, according to the potential of the genotype available.

Based on those grounds, this paper shows an analysis of the commercial feed administration system during pre-fattening and fattening of pigs on the Rescate de Sanguily farm, and the feasibility to apply some alternatives based on other sources of nutrient.

MATERIALS AND METHODS

This study took place between January and June, 2015, at the Rescate de Sanguily Swine

UEB (local branch company), on Carretera de Vertientes, Km 5 ½, municipality of Camaguey.

Bromatological analysis was performed to comercial feed samples, and their dry matter and crude protein contents were determined (mean values of 88.5% and 15.71%, respectively), using the AOAC techniques (1995).

Nutrient DE and CP contribution was estimated, according to the composition reported by the feed processing plant and the mean values for the raw materials (soybean and corn meal), based on different sources, through the Pearson square and the correction factor.

The cost per kilogram and ton was set, based on the costs of the raw materials and their inclusion degree in the commercial feed.

Nutrient contribution analysis per stage was made, according to the values achieved in the previous estimations and recommendations of feed consumption.

Non-conventional raw materials were used to produce alternative rations at minimum costs, through simulation techniques (Confort, 1997).

Economic feasibility was compared between the costs of single feed (soybean and corn meal), and the non-conventional one.

The costs were calculated from the consumption values of the commercial feed, per stage, according to the local standards and duration of the stages.

The values achieved were compared to the National Research Council (NRC), for animal development stages.

The costs were compared between the single feed and the variants made with alternative resources.

RESULTS AND DISCUSSION

Tables 1; 2; 5; and 4, show the comparison and evaluation values for the commercial feed used on the farm, and the feeding scheme applied.

Table 5 shows the comparison of requirements (figures suggested by the Ministry of Agriculture, 2008) with the real consumption values in pigs fed with the commercial feed.

CP consumption during pre-fattening and fattening was slightly above the NRC recommendations (1998) for pre-fattening; for the next stage, the difference was widened, in terms of the set requirements for the stage. Between 65 and 75% of feeds in Swine systems are consumed during the fattening stage. Moreover, feeding accounts for most of total production costs, and minor cost reductions associated with the fattening stage have significant repercussions on cost effectiveness. Accordingly, it is important to specify animal nutritional needs. Deficient nutrition will lead to a decrease in pig growth, whereas nutrient excess is a waste that is usually costly, especially concerning protein. In addition, some minerals like phosphorous cause environmental deterioration (Pomar and Dit Bailleul, 1999).

Animal protein and amino acid demands were based on weighing specific requirements for every tissue, so much that during growth, skeletal muscle accumulation accounted for 36 and 46% weight gain. The demand for synthesis of meager tissue, plus other tissues, as well, is what eventually defines total requirements (Cuarón, 1999).

Considering the changing process (permanent synthesis cycle, degradation, and protein resynthesis in the metabolism), the muscular protein volume is the one with the best explanation of animal growth requirement, so, in comparison to other tissues, the muscle has a lower metabolic rate; whereas its volume is relatively large. In absolute terms, meager growth is small at the beginning of fattening, but it grows quickly (maximum of 40-75 kg live weight), to diminish later (Schinckel et al., 1996).

For DE, the values are under the needs or requirements given for the study stages. The net energy value of a ration tends to go up along with animal weight increase, caused by meager (muscle) deposit reduction, in relation to lipid deposit (fat). Actually, the lipid deposit is more efficient in terms of energy than the meager deposit (Van, Milgen and Noblet, 1999).

These results show that the net energy values of a ration are affected by its composition and the nutritional level, the genotype, and the physiological state of the animal.

Also, it would be important to analyze the consumption set for animal feed. Generally, the animal consumes feeds to meet the energy demands, which takes place within certain ranges of feed energy density; such as, the capacity to compensate with consumption, low metabolizable energy diets increase with the pig´s age or weight. For instance, suckling pigs under 20 kg will hardly eat sufficient amounts of feed to overcome the metabolic demands. Therefore, the storing capacity increases with lipids. In opposition to it, the results achieved do not show the expected values for the stages, which is an important point to assume that the ration´s energy density must be in accordance to the animals´ needs.

Different behaviors may be observed in diets with relatively high protein contents, like the ones found in a study where high protein (HIPRO) diets were used. Additionally, mean daily gain (MDG) was observed in the animals fed longer with it. When the diet was used for several days before sacrifice, feed ingestion dropped, and weight gain worsened the conversion indexes (Leheska et al., 2002).

Energy distribution relations change during growth, and they are affected by environmental factors, so an optimal range between amino acids and energy is necessary in commercial feed rations.

In the fattening and pre-fattening stages the values achieved through commercial feed increases in the set amounts, daily costs, per stage and totals, are shown in Table 6.

In comparison to these values, a formulation was made, which included alternative sources made in the country (Table 7).

The mixture was designed for pre-fattening, and the approximate cost per kilogram was $0.27 USD. Note the $0.34 USD in the commercial feed type.

Thus, considering its effect in terms of nutrition, the animal requirements are met, contrary to the case of soybean and corn, when energy contributions were below the requirements for both stages assessed.

Protein requirement adjustments respond to one of the problems discussed in this paper: feasibility to reduce costs of production of feed mixtures, by including national raw materials, or a more efficient use of conventional ones. Furthermore, excess metabolic deamination in the animals must be avoided, which may affect their ecosystems.

Fat and molasses in the rations is a choice for energy increase. Using that variant, Lon-Wo and Gutiérrez (1991) were able to improve efficiency of nutrients in turkeys.

In tropical weather, high temperatures have a depressing effect on consumption, so it is important to modify energy concentration of rations. Fat inclusion improves ingestion as metabolic cost, because the fat catalytic processes demand less energy waste, which leads to better inner animal disposition and minimal energy losses (Stein, 2011).

Pigs have positive yields when they receive several combinations of ingredients; therefore, the challenge to dieticians is to identify which combination is the most efficient to meet their needs without changes in production (Stein, 2011).

The inclusion of hay from legumes is another choice to lower the costs of rations and improve their bromatological composition, with diet fiber, minerals and vitamins. Vestergaaed (1997) stated that one of the most viable alternatives to lower costs in tropical regions was through partial inclusion of forages in the diet, by making good use of the great diversity in the region. They are good sources of vitamins and minerals, and they provide a feeling of fullness, and, in turn, a reduction of the hunger period.

The wide variety of products for inclusion in pig rations is necessary today. Accordingly, Cruz (2006) considered that it is an imperative to move into participatory agricultural development with local actors, in order to identify potentials in the location, and evaluate the effect of actions to solve municipal problems. Also important will be the knowledge networks, and the interrelations ensued, that lead to new strategy designs for production and marketing of feeds, making optimal use of soils and product diversification.

A ration was made for the final stage (Table 8).

Comparing the cost of single feeds and the alternative ration for the final fattening, there is a difference in favor of the alternative mixture. It not only reduces costs of corn and soybean, but also minimizes energy deficits.

It is important to consider that the nutritional requirement values presented in the Manual of Swine Raising (Center for Swine Research, 2005) match the values set by other countries with differences in terms of production conditions, animal type and gathered experience, according to Savón et al. (1994).

Regardless of the above, the ration formulation procedures have had economic feasibility. It is also important to consider that in terms of nutrition, adequate feed intake requires proper evaluation of the nutritional potential of raw materials available, and the determination of nutritional needs. However, the latter is not an easy task. As a matter of fact, several intrinsic factors (the genetic type, sex, etc.) and extrinsic (temperature, health, etc.) can alter the metabolic functions of animals, and, in turn, the amount of nutrients needed for optimal growth and meager deposit (Pomar and Dit Balleul, 1999).

According to experiences in Cuba, conventional feeds have proven their effectiveness to replace traditional raw materials totally or partially. Hence, it is possible to lower the costs of production to make pork production competitive and cost effective in tropical countries. In Cuba, particularly, these products have widened their scope because they can increase the availability of raw materials, and reduce or eliminate the imbalance created in animal nutrition (Díaz, 1996).

CONCLUSIONS

According to the standard supplies, the protein levels found in the commercial feed type were either excessive or deficient at times in relation to the animal requirements. The costs of production were subsequently increased, and nutritional unbalances were observed, making feed rations costlier than the alternative feeds made for the stages in the study, using non-conventional raw materials.

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Table 1. Average general composition of corn and soybean

Raw material	CP	DE (Mcal/kg)
Corn (USA)	8.1	3.4
Soybean (44)	44	3.3
Corn (Spain)	7.7	3.44
Soybean (toasted)	36.3	4.13
Corn (France)	8.3	3.43
Soybean (44)	46.9	3.36
Corn (Cuba)	8.5	4.03
Soybean	43.5	3.9
Corn average	8.15	3.6
Soybean average	42.7	3.7

Source: FEDNA(2003), Manual of Feed Production (2005)

Table 2. Estimated single feed composition, according to the farm report, and the average values from two different sources

Raw material	Inclusion percent	Contribution (for 100% of feedstufs)		Fact.	Correc.
		DE (Mcal/kg DM)	CP (g/kg DM)	DE	CP
Corn	67	2.4	54.6	2.3	52.4
Soybean	29	1.05	126.2	1.0	118.0
Salt	2	0	0	0	0
Pre-feedstuff mixture	2	0	0	0	0
Total	100	3.45	180.8	3.3	170.4

Table 3. Estimation of cost of single type feed used in prefattening and fattening pigs

Raw material	Inclusion percent of the feed mixture	Cost kg (USD)	Cost kg feed mixture (USD)	Cost ton.
Corn meal	67	0.29	0.194	

Soybean meal	29	0.49	0.142	
Total	96	0.88	0.34	340

Values reported by the Central Bank of Cuba (2015)

Table 4. General scheme for pigs in the fattening program

Weight range, kg	18-35	35-90
Age, days	96	180
Days in the stage	35	84
Final weight kg	35	90
Mean gain g/day	486	615
Feed consumption, kg	1.80	2.81
Feed conversion, feed kg/increase	3.70	4.44

Source: Farm Delivery Standards

Table 5. Comparison of DE and CP requirements to real consumption in pigs fed with commercial feed

Categories	Consumption kg DM		CP consumption (g/day)			DE consumption (Mcal/day)		
	Demands	Real	Demands	Real	Dif.	Demands	Real	Dif.
20 to 50 kg	1.8	1.8	285	306	+21	6.45	5.94	-0.51
50 to 100 kg	2.8	2.8	404	476	+72	10.56	9.24	-1.32

Tabulated values in Cuban Standsards of Swine Nutrition, and values estimated with production figures

Table 6. Cost calculated per day, stage, and totals for prefattening and fattening using the commercial feed type, and calculated values

Category	Cost. Feed kg (USD)	Cons. kg/day	Days in the stage	Cons. total kg in the stage	Cost per stage (USED)
Prefattening	0.34	1.8	35	63.0	21.42
Fattening	0.34	2.8	84	235.2	79.97
Totals				298.2	101.39

Table 7. Alternative ration for pre-fattening

Raw material	Inclusion %	Mixture CP contribution (g/kg)	Mixture DE/kg contribution (Mcal)	Cost (USD) of raw material kg	Cost (USD/kg) of mixture
Corn	50	40.75	1.8	0.29	0.145
Broken rice grain	5	4.1	0.15	0.15	0.008
Sunflower meal	5	21.0	0.15	0.25	0.013
Soybean meal	18.8	82.53	0.65	0.49	0.092
Molasses	8.7	2.62	0.36	0.05	0.004
Legume meal	5	7.0	0.11	0.01	0.0
Bovine fat	4.5	0.0	0.38	0.05	0.002
Salt	1.0	0	0	0.01	0.001
Pre-feedstuff mixture	2.0	0	0	0.25	0.005

Totals	100	158	3.6	1.49	0.27
Demands		158	3.6		
Difference		0	0		

From CONFORT

Table 8. Alternative ration for final fattening stage

Raw material	Inclusion %	Mixture CP contribution (g/kg)	DE contribution mixture Mcal/kg	Cost kg (USD)	Cost (USD/kg) of mixture
Corn	40.4	34.34	1.45	0.29	0.117
Sorgho	20	18.6	0.69	0.10	0.02
Sunflower meal	10	42.3	0.30	0.25	0.025
Soybean meal	11.6	50.7	0.43	0.49	0.06
Fat	5	0	0.43	0.10	0.01
Sugar	10	0	0.42	0.23	0.023
Salt	1.0	0	0	0.01	0
Pre-feedstuff mixture	2.0	0	0	0.15	0.003
Totals	100	146	3.72		0.255
Demands		144	3.73		
Difference		2	-0.01		

From CONFORT