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Original article

Nutritional indicators for price formation of protein plants for animal consumption

Indicadores nutricionales para formar los precios de las plantas proteicas de consumo animal

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ABSTRACT: The objective of the work was to present a proposal for the formation of prices of alternative inputs to animal feed using bromatological or nutritional indicators, which can favor the generalization, processing and sale of protein plants, based on considering their nutritional values. The evaluation of these alternatives also required identifying the costs of their production to know, from this perspective, the minimum price acceptable to the producer, which together with the market price offered by the proposed method, resulted in a novel approach in the conceptual order and price practical. With the application of the algorithm to form prices described in the work, the objective of making visible to agricultural producers and pig farme rs, the nutritional and economic advantages of the use of protein plants and how it is possible to link it with prices was met. The application of nutritional indicators in the formation of the price of a product by correlation with a similar one in the market, constituted a scientific innovation, which contributed new theoretical criteria to prices and contributed to solving a problem of the production of animal feed in the country.

Keywords: Protein, digestibility, moringa, soja, bromatology.

RESUMEN: El objetivo del trabajo consistió en presentar una propuesta para la formación de precios de insumos alternativos a la alimentación animal utilizando indicadores bromatológicos o nutricionales, que pueden favorecer la generalización, procesamiento y venta de las plantas proteicas, a partir de considerar sus valores nutricionales. La evaluación de estas alternativas requirió identificar los gastos de su producción y conocer, desde esta perspectiva, el precio mínimo aceptable para el productor, lo que junto con el precio de mercado que ofreció el método propuesto, resultó un enfoque novedoso en el orden conceptual y práctico. Con la aplicación del algoritmo para formar precios descrito en el trabajo, se cumplió el objetivo de visibilizar a productores agrícolas y porcicultores, las ventajas nutricionales y económicas de la utilización de las plantas proteicas y cómo es posible vincularlo con los precios. La aplicación de indicadores nutricionales en la formación del precio de un producto por correlación con uno similar, constituyó una innovación científica, que aportó nuevos criterios teóricos a los precios y contribuyó a resolver un problema de la producción de alimento animal en el país.

Palabras clave: proteína, digestibilidad, moringa, soja, bromatología.

INTRODUCTION

As is well known, Commander in Chief Fidel Castro devoted his last energies to investigate substitutes for the food base of cattle in Cuba, with the firm conviction that the protein plants: Moringa, Mulberry and Tithonia were capable of replacing, in a significant way, the imported food on which the pig's current diet is based (1).

The current scientific problem is the expansion of the use of protein plants. Agricultural producers say that prices do not cover their expenses and pig farmers are not convinced that their use is efficient in swine feeding (2). Dozens of published articles refer to agricultural development and the nutritional effect of these plants, but do not address the prices and economic convenience of their use (3).

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The objective of this work is to present a proposed methodology for the pricing of these alternative inputs using bromatological or nutritional indicators, which, both theoretically and practically, could enhance the generalization, processing and sale of protein plants as substitutes for imported products for animal consumption, considering their nutritional values (4).

The evaluation of these alternatives also requires identifying the costs of their production (5) in order to know, from this perspective, the minimum acceptable price for the producer, which together with the market price offered by the proposed method, is a novel approach in the conceptual and practical order in terms of prices.

Assuming as a perspective the Food Sovereignty and Security Law, which establishes nutritional education as one of its important axes, it is necessary to work in the future in the determination of the price for human food from these concepts, which favors in an expeditious way the identification of the quality and price of the food of the population with the positive effect that it provides in its health (6).

MATERIALS AND METHODS

In order to determine the price of protein plants based on bromatological indicators, the following was required:

I. To know the nutritional indicators of the products involved in the price calculation.

II. To determine the price formation methodology, according to the nutritional or bromatological indicators.

Regarding the nutritional indicators of the products (I), the information provided by the Swine Research Institute of the Ministry of Agriculture was used.

The steps required to obtain the necessary information were as follows:

1. Identify as indicators that would make up the price. Positive: crude protein (CP), digestible kilocalories (DE, Mj/k) and dry mass (DM). Negative: ash (CZ)
2. The bromatological analysis of the similar product was soybean meal.
3. It is known that the main objective of soybean industrialization is to obtain oil; however, the by-products of this process (expellers and meal) are of crucial economic and commercial importance due to their massive use for animal feed. These are especially valuable for their high protein content and quality (7).
4. Bromatological analysis of the protein plant, Moringa oleifera.

Great importance is given to *Moringa oleifera* in animal feed, since due to its protein and vitamin content it can be an important supplement in dairy and fattening cattle, as well as in the diet of poultry, fish and pigs, provided there is a nutritional balance (8).

About the price formation methodology (II), according to nutritional indicators, it was required:

1. Identify the market price of a product with similar nutritional characteristics (Px).
2. Determine by means of criteria of judges, the weighted value (percentage) of the nutritional characteristics of the similar product in the market (Xi) (9).
3. Establish between the protein plants (Py) and the market product the percentage proportion in each nutritional indicator (Yi).
4. Perform similar procedure with the negative indicators (Yi), where this indicator is identified as (Cj).
5. Perform the corresponding calculation operations.

Considering the relationships between the above related indicators, the following general algorithm was identified:

$$Py = \sum_{i=1}^{n} (Px*Xi*Yi) - \sum_{j=1}^{n} \{Px*\lfloor Xj*(Yj-1)\rfloor\} \quad (1)$$

The application as a whole of the data and the applied procedure yielded the following results.

RESULTS

The conceptual basis for the price formation of protein plants, considering bromatological indicators (Table 1), consisted of the quantitative comparison of their most relevant nutritional components. It took as a platform a similar product in the market and the weighted value of its nutritional values in its price (10).

It was also considered: that there are indicators that have a negative behavior for the price formation, because to the extent that they increase or decrease in the product, in correspondence behaves the damage that causes in the product and that in the consumption of these plants dietary restrictions are required that determine the total consumption, although in its more elaborated state as flour, it can be superior (11). Table 1 (12).

The obtained data used were:

Price of *Moringa oleifera* (Py)= ¿?

Price of soybean meal (Px)= 12 300 CUP t^{-1}

Application and results:

$$Py = \sum_{i=1}^{n} (Px*Xi*Yi) - \sum_{j=1}^{n} \{Px*\lfloor Xj*(Yj-1)\rfloor\} \quad (2)$$

$$Py = (Px*X1*Y1) + (Px*X2*Y2) + (Px*X3*Y3) - \{Px*\lfloor X4*(Y4-1)\rfloor\}$$

$$Py = (12300*0.6*0.130) + (12300*0.2*0) + (12300*0.1*0.21) - \{12300*\lfloor 0.1*(0.4545-1)\rfloor\}$$

$$Py = 1212{,}70 + 553{,}50$$

$$Py = 659{,}20 \text{CUP t}^{-1}$$

In order to present in a more accessible way, the calculation analysis presented in the following tables (Tables 2 and 3), similar data processing is applied, obtaining the same result.

DISCUSSION

The applied procedure of calculating the price by quantitative correlations of bromatological indicators allows Moringa and other protein plants to be valued for their nutritional effect on the pig, compared to that of soybeans. This condition offers greater objectivity to the determination of the price, thus dispelling doubts about its efficiency and stimulating the production and consumption of these alternative inputs (13).

It is reasonable that the price determination carried out considers as a reference or starting point a protein product such as soybean meal and considers other influential concepts such as: digestibility, laboriousness required by each input, perishability and others, since they can increase or decrease it (14). Also, the price fixed by correlation when estimated, according to the market, can be decreased by 10 or 20 % to stimulate its consumption in relation to soybeans (15).

The above evaluation of the price of Moringa should be complemented with the identification of reasonable costs and profits. According to data from the Agroindustry Directorate of the Ministry of Finance Prices, the price calculated by the cost method for a ton of Moringa is 480 pesos, which allows a margin of 179.20 pesos per ton in favor of the producer, which stimulates its production and commercialization.

The application of this procedure can be extended to plants that provide energy and vitamins for pig or other animal feed.

Considering these criteria and assuming as a perspective the Food Sovereignty and Security Law, which establishes nutritional education as one of its important axes, it is necessary to work, in the future, in the determination of the price for human food from these concepts, which favors in an expeditious way the identification of the quality and price of food with the healthy effect it provides.

Table 1. Weighting and bromatological indicators

Concept	%	Bromatological indicators
Positive values		
CP in (Px). (X1)	60	42.60
CP in Moringa. (YJ)	60	5.56
DE in (Px). (X2)	20	12.41
DE in Moringa. (Y2)	20	
DM in (Px). (X3)	10	90.00
(DM) in Moringa. (Y3)	10	19.45
Negative values		
CZ in (Px). (X4)	10	7.70
CZ in Moringa. (Yj4)	10	3.51

crude protein (CP), digestible kilocalories (DE), dry mass (DM), ash (CZ)

Table 2. Price determination (Cuban Pesos, CUP) of the moringa oleifera (12). Soybean meal price: 12 300 CUP t^{-1}

Positive values						
Concepts	**% similar value**	**Soybean meal weighted value**	**Soybean meal absolute value**	**Moringa absolute value**	**Moringa Percentage value**	**Total correlated value**
Protein	60	7380.00	42.60	5.56	0.130	954.40
Energy	20	2460.00	12.41			
Dry mass	10	1230.00	90.00	19.45	0.21	258.30
Total	90	11.070.00				1212.70

Soy flour price: 12 300 CUP t^{-1}

Table 3. Determination of the price (Cuban Pesos, CUP) of moringa by correlation (12). Price of soybean meal: 12 300 CUP t^{-1}

Negative values						
Concepts	**% similar value**	**Soybean meal weighted value**	**Soybean meal absolute value**	**Moringa absolute value**	**Moringa Percentage value**	**Total correlated value**
Ash	10	1.230.00	7.70	3.51	0.455	553.50

Final prize: 1212.70-552.50= 659.20 CUP t^{-1}
Soy flour price: 12 300 CUP t^{-1}

CONCLUSIONS

1. With the application of the price formation algorithm described in this work, the objective of making visible to agricultural producers and pig farmers the nutritional and economic advantages of using moringa and, in general, protein plants, as a substitute for soybeans, is achieved.
2. The application of nutritional indicators in the formation of the price of a product by correlation with a similar one in the market, constitutes an innovation, which contributes new theoretical criteria to the prices and contributes to solve a current problem of animal feed production in the country.
3. Con la aplicación del algoritmo para formar precios descrito en el presente trabajo, se cumple el objetivo de hacer visible a productores agrícolas y porcicultores las ventajas nutricionales y económicas de la utilización de la moringa y, en general, las plantas proteicas, en sustitución de la soya.

RECOMMENDATIONS

1. Extend the price determination algorithm with bromatological indicators to other products that can replace animal feed, both protein and energy plants.
2. Promote, through communication channels and economic organizations, the nutritional and economic advantages of the use of protein plants.

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