



Original

Characterization of the actors in the pasteurized milk chain in the province of Sancti Spíritus, Cuba

Caracterización de los actores de la cadena de la leche pasteurizada en la provincia de Sancti Spíritus, Cuba

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ABSTRACT

Background: The study of chains at a local level starts from a new configuration constitutes a new working philosophy in the agri-food sector in Cuba.

Objective. The aim of the paper is to characterize of the actors in the pasteurized milk chain in four municipalities of Sancti Spíritus province.

Como citar (APA)

Hernández García, J., Ponce de León, A., Nápoles Gómez, J., Rodríguez Álvarez, L., Gómez Brito, O., & Gutiérrez Jorge, M. (2022). Characterization of the actors in the pasteurized milk chain in the province of Sancti Spíritus, Cuba. *Revista de Producción Animal*, 34(1). <https://revistas.reduc.edu.cu/index.php/rpa/article/view/e4045>



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Methods: It was based on the primary and secondary available information obtained at workshops with the participation of national actors and international experts. The characterization of the actors included the variables described in previous chain studies, the construction of the SWOT Matrix and an action plan.

Results: The links of the chain are: Production, collection, processing and marketing. At the primary sector, there are different productive farms with non-governmental dominance. They had a production of approximately 20,000 liters/year, having 20 not specialized female cattle in milk production. Some of the farms use animal traction for milk collection and the industry does this process with tank trucks. The processing link presents technology with limitations and insufficient equipment. The SWOT Matrix revealed that the nutrition is not sufficient and the composition of milk is not good. Besides, the process of collection and the industrial distribution that affect the quality of milk.

Conclusions: The characterization of the actors showed that in the primary link with predominance of the non-state sector, but there is low milk production. For the collection of milk, they use animal traction and tanker trucks. Obsolete technologies are found in the processing link, while commercialization actors are limited by hygienic conditions.

Key words: Dairy production, dairy cattle, dairy value chain food chain, food access, pasteurized milk (*Source: AGROVOC*)

RESUMEN

Antecedentes: El estudio de las cadenas a nivel local constituye una nueva filosofía de trabajo en el sector agroalimentario en Cuba.

Objetivo. El objetivo del trabajo fue caracterizar los actores de la cadena de la leche pasteurizada en cuatro municipios de la provincia de Sancti Spiritus.

Métodos: Se basó en la información primaria y secundaria disponible obtenida en talleres con la participación de actores nacionales y expertos internacionales. La caracterización de los actores incluyó las variables descritas en estudios de cadenas previos, la construcción de la Matriz DAFO y un plan de acción.

Resultados: Los eslabones de la cadena fueron: Producción, recolección, procesamiento y comercialización. En el sector primario, existen diferentes fincas productivas con predominio del sector no estatal. La producción aproximada por fincas era de 20.000 litros/año y contando con rebaños de 20 hembras, no especializadas en la producción de leche. Algunas granjas utilizan tracción animal para la recolección de leche y la industria realiza este proceso con camiones cisterna. En el eslabón procesamiento se observó limitaciones tecnológicas y equipamiento insuficiente y en la comercialización deficiencias en las condiciones higiénicas. Los análisis de la matriz DAFO ponderó como principales variables la insuficiente nutrición de los animales y las afectaciones de la calidad de la leche a lo largo de la cadena.

Conclusiones: La caracterización de los actores mostró que en el eslabón primario predomina el sector no estatal, pero tiene muy baja producción de leche. Para la recolección de la leche, utilizan camiones cisterna y la tracción animal. En el eslabón de procesamiento se encontraron tecnologías obsoletas y equipos insuficientes, mientras que los actores de la comercialización están limitados por las condiciones higiénicas.

Palabras clave: Acceso a alimentos, cadena alimentaria, cadena de valor láctea, ganado lechero, leche pasteurizada, producción láctea (*Fuente: AGROVOC*).

Recibido: 12/3/2021

Aceptado: 7/6/2021

INTRODUCTION

The new schemes of agricultural production, the dynamics of the commerce from the point of view of the globalization of economies and markets, as well as the increasing public attention on quality, environmental protection and international regulations require a new overview (Amirnejad and Tonakbar, 2015; Daou *et al.*, 2020; Ledo *et al.*, 2020; Martínez *et al.*, 2017).

Sancti Spíritus province, Cuba has a great agricultural tradition and milk is one of the major products enhancing its socio-economic development. Nowadays, the province has considerable masses of cattle of different Races and productive farms. These potentialities should be enhanced to meet the population's needs in terms of quantity, quality and safety.

The production chain is a system that begins from the primary production up to the consumption. It integrates the actors (men and women) with different characteristics and with specific roles. They develop cross-linked and interdependent activities around the evolution and performance of a product, which attempts to be competitive for the local or regional development (Simanca *et al.*, 2016). The concept of productive chain is an increasingly used alternative for studying the components and the relations of the agents (Ríos *et al.*, 2016), which are necessary to visualize reality and territorial interests (Imelda *et al.*, 2017, Barati and Kalantari, 2017; Food and Agriculture Organization, 2014; Van Campenhout *et al.*, 2019).

For a better competitiveness of a production chain, it is necessary to implement two types of complementary stages: 1) Analysis of the productive chain; and 2) strategy for decision making (Van der Heyden and Camacho, 2004). SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats) is an important tool to analyze and think strategically about the development of agricultural chains (Baudino *et al.*, 2017). A SWOT analysis will help the agricultural chain to identify their critical strategic factors. Once they are identified, they are starting points to support organizational change: consolidating the strengths and minimizing the weaknesses, taking advantage of opportunities, and eliminating or reducing threats. The SWOT analysis is based on two pillars: the internal analysis and external analysis of the chain (Moghaddaszadeh *et al.*, 2015).

In Cuba, some works have been carried out in the last years focusing on production chains (Armenteros-Amaya *et al.*, 2020; Hernández-Rodríguez *et al.*, 2020)

There are important elements in the strategy of the Cuban Ministry of Agriculture and it is reflected in the National Science Program on Production of Human Food (Ministry of Science, Technology and Environment [MSTE], 2020). This research was part of the plan of activities

conceived in the project "Agrocadena: support program for the strengthening of Agrifood Chains (AGROCADENAS) prioritizes the study of the milk, promoted by the United Nations Development Program (UNDP) and the Ministry of Agriculture, with the collaboration of the Ministry of Internal Trade and the Ministry of Food Industry and financial support from the European Union (EU) and the Swiss Agency for Development Cooperation (Cosude/SDC).

This paper aims to characterize the actors in the pasteurized milk chain in the province of Sancti Spíritus, Cuba and to propose strategic objectives for its development.

MATERIALS AND METHODS

For the development of this research in four municipalities of the local level in Sancti Spíritus province, Cuba: Cabaiguan, Fomento, Yaguajay and Sancti Spiritus, this study was carried out from 2014 to 2017, the indications of the methodology were focused on production chains as described by other authors (Van der Heyden and Camacho, 2004, Suárez-Castellá *et al.*, 2016).

To overcome the concerns regarding being simplistic or subjective in the analysis of agricultural chain, primary data were collected by authors through field observations and in-depth interviews with key stakeholders. The data included information provided in meetings and questionnaires filled in by various actors in different moments of the study (Table 1). Secondary data were collected from related publications and documents issued by the competent institutions in the province. The official statistics on trends in production, market and consumption of milk and other milk products in Cuba and the world were also included in the analysis (Martínez *et al.*, 2017).

Table 1. Behavior of actors' participation in the analysis of the different chain links.

Links	Workshops	Participants	Male	Female
Preparatory	6	348	255	93
Determination of scope	7	149	30	119
Analysis of background, surroundings	3	121	91	30
Actors' analysis	3	216	168	48
Planning (SWOT analysis)	3	75	48	27
Total	22	909	592	317

Besides, secondary information was obtained at workshops with the participation of national actors and international experts with great experience on agricultural chain links. The analysis of the plan links was also taken into consideration (Saiz and Castañedo, 2016).

Phases of the study

The study included the following phases:

- **Preparatory (motivation and learning)**

In order to guarantee the communicative level, the workshops were developed in different levels: municipal, provincial and regional. They involved 348 participants, 73 % were men and 27 %, women. As previously mentioned, in each of these workshops various experts participated.

The participants included: managers of all levels of the territory; producers, specialists, technicians, experts and representatives from Nongovernmental Organization, as well as representatives of Agricultural Projects. Other organisms had also a significant performance in the mentioned activities. They were: Ministry of Science, Technology and Environment; Institute of Hydraulic Resources; Credit and Commerce Bank. National Insurance Enterprise; Group of Logistics of the Ministry of Agriculture; National Association of Small Farmers; Cuban Association of Animal Production; National Center of Animal Control; Provincial Weather Center of Sancti Spíritus; Provincial Group of Economy and Planning; Provincial Direction of Finances and Prices; Dairy Industry; Department of Commerce; Provincial Delegation of the Ministry of Agriculture; Territorial Office of Normalization; Experimental Station of Pasture and Forages in Sancti Spíritus; the Institute of Veterinary Medicine; and the University of Sancti Spíritus, which played an important role for the organization of the research.

- **Determination of the scope of the diagnosis (chain, objective, product, territories).** For the selection of the chain the following criteria was taken into account: i) National strategies (import substitution), ii) High demand (industries of the territory), iii) Tradition, culture and potentialities, iv) Profitability and v) Jobs.
- **Analysis of the context** where the chain is applied, including background, environment, regulatory frame and infrastructure.
- **Direct actors in the different links (production, collection, processing and marketing), and different indirect actors** were included in the study: i) Regulating entities and organizers, ii) Service suppliers, iii) Suppliers of raw materials
- **Analysis of the sub-processes.** For the analysis of the sub-processes of the links of the chain, the productive flow was constructed to identify the critical points for the improvement plan.
- **Actors' characterization.** The group criteria included:

Production link: Form of organization: the ones of the state form and not state sector. Volume of total milk production ($10^3\text{L}/\text{year}$): High (>40.0), Medium ($20.0 - 39.9$) and Low (<19.9). Number of female cattle (heads): Large (>50), Medium ($20 - 49$) and Small (<20).

Collection link: Means of transportation: animal traction or motorcar. Distance to the cooling point (km): less than 3 km, 4 to 6 km, 7 to 10 km and more than 10 km. Destination: Directly to the sale point or to the cooling point.

Processing links: The industrial dairy processing sector in Sancti Spíritus province, Cuba, was classified according to three criteria: their industrial capacity (quantity of milk processed yearly), their localization and the type of products they sell (drinking milk and/or dairy derivatives).

Marketing links: Market: Wholesaler and retailer. Customer: Social consumption and other markets.

Construction of the SWOT Matrix. SWOT analysis is a method that can be used to explore the Strengths, Weaknesses, Opportunities and Threats of a particular issue. It has many applications in various fields, including the food chain (Rafeeian and Taji, 2017, Trejo *et al.*, 2016).

Statistical analysis. The data were analyzed with the statistical program SPSS 15.0.1 for Windows. A comparison of proportions was used, considering in all cases a significance level of 5%.

RESULTS AND DISCUSSION

In the historical analysis of the dairy chain operation in Sancti Spíritus province, Cuba, there were shown the number of the principal moments for the development of the chain for pasteurized milk; the number of moments (Figure 1). It was predominant the post-revolutionary periods, specifically in the stage 1959-1980 and in 2000.

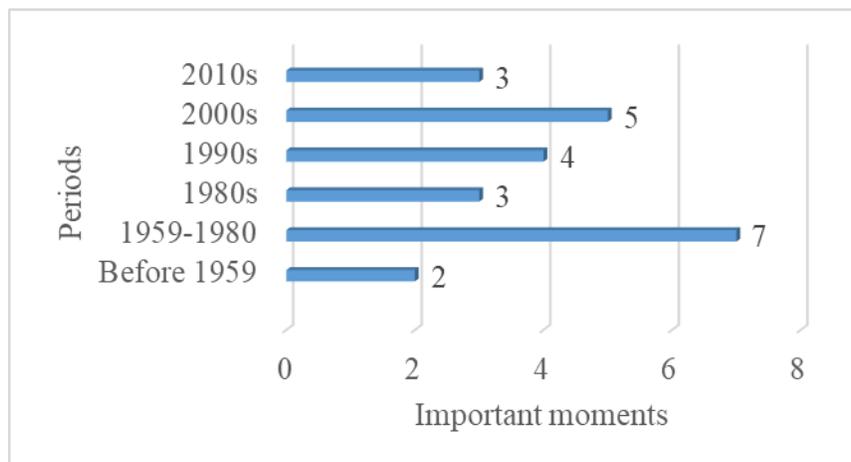


Fig. 1. Number of important moments in the development of the chain of pasteurized milk at Sancti Spíritus province, Cuba.

According to the scope of the pasteurized milk chain, it was defined the primary and secondary products: Primary: Pasteurized milk in bags of 917 mL end Secondary: Yogurt, cheese, ice

cream, butter, powdered milk. The elaboration of the map of the chain in a participatory way allowed to visualize it with its links and actors (Figure 2).



Fig. 2. Map of the chain of the bovine pasteurized milk. It included four links.

Directs actors are integrated for: i) Production: Cooperatives (Credit and Services Cooperatives), Agricultural Workers of the Cooperatives, Basic Units of Cooperative Production, Governmental Basic Unit for Agriculture and Individual producers, ii) Collection: Milk carriers, Independent collectors and collectors of the Dairy Industry, iii) Processing: Locality of the factors and Basic Unit implied. There are three industries in the province: two factories in Sancti Spíritus city and Merida, in Yaguajay municipality. They assume these roles, but the pasteurized milk is only produced in Sancti Spíritus and iv) Marketing: Basic Unit for the industry and the Governmental Unit of Commerce in the province.

Different indirect actors were included: i) Regulating entities and organizers: They include different entities; some of them belong to the Ministry of Agriculture, Health entities, Entities for Science and Environment, Food Industry, Basic Industries and Commerce, ii) Service suppliers: Twelve entities were identified as suppliers, many of them belonging to the Ministry of Agriculture (five), Nongovernmental Organizations (two), the University and other Research Centers, the nongovernmental sector, the Credit and Commerce Bank and the Ministry of Basic Industry, iii) Suppliers of raw materials: Cuban Oil Industry, National Laboratories for Biopharmacy Industries, Enterprise for marketing, Ministry of Basic Industry, Industry of Containers, National Enterprise of Agricultural Supplies. They are summarized in table 2.

Table 2. Summary of the number and classification of indirect actors.

Indirect actors	Suppliers of Raw Materials				Logistic				Regulating			
	Production	Collection	Processing	Marketing	Production	Collection	Processing	Marketing	Production	Collection	Processing	Marketing
	5	2	4	1	0	0	4	0	3	2	4	2
	Financial services				Training Services				Technical Assistance			

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	Production	Collection	Processing	Marketing	Production	Collection	Processing	Marketing	Production	Collection	Processing	Marketing
	2	0	3	1	8	1	1	0	7		10	1

The study of the links generated positive impacts and learning.

- It is necessary to consider in the elaboration of the strategies the non-feasibility of depending on only one market because it limits the development of potentialities in the dairy chain in Cuba.
- The programs have to be accompanied by the necessary links to do a best use of the lands of the country.

Regarding the Cuban governmental **policies** on valuable chains, 23 policies are related to the agricultural production and 19 are specifically linked to the development of the bovine cattle. Regarding **environmental factors**, they included climate, temperature and influences of bio-productive indicators and water. Water is an abundant resource in the province. The access to it has been limited in periods of drought that affect the systems of irrigation. Winds and the meteorological events were the others two variables that were taken into consideration. These factors have impacts of the milk production in cow (Conejo-Morales, WingChing-Jones, 2020, Kumar *et al.*, 2020, Tao *et al.*, 2020).

The **infrastructure** affected the development of the dairy chain. Its incidence was shown in the different links and it evidenced weaknesses in the electric system and communication variants (telephone, e-mail, etc.). **Energy** is another indicator very associated to productivity and efficiency in the different links, showing a weak use of renewable sources.

Regarding the **socio-cultural facts**, the province has 465,674 inhabitants, that is, 68.7 inhab./km². They are 50.7% men and 49.3% women (index of masculinity: 1.028). The housing development is 70 %. Sancti Spíritus is the most populated city and the principal municipality. The growth in the population is slow, becoming evident a gradual increase of the population over 60 years, accompanied of low birth rates and a negative migratory balance in the province. The socio-cultural facts were including for Alhammd, (2020); in his study of characteristics of Dairy value chain in Jordan.

The workers at the cattle sector are in an advanced age; the majority of them belong to the age groups: 51 - 60 years and over 60 years. Their level of education is varied. The experience of these workers is a potentiality for the tradition and cattle culture of the province. Women represent about 50% of the technical staff in other sectors, but in the cattle sector, they do not surpass the 15%. They do not have a high percentage in the occupational categories: Executives and Managers.

Table 3 shows the principal sub-processes that were verified in the different links of the chain of the pasteurized milk in Sancti Spiritus province, Cuba. The only common sub-process was planning.

The analysis of the production chain in each sub-process and process was an exercise where the actors attempted to know and to understand the status and functioning of the productive chain. It enabled to identify the critical points that slow down the competitiveness of the chain and the competitive advantages that enhance the development. This exercise of analysis must allow also acknowledging and visualizing the principal barriers of participation and breaches of access to opportunities and resources that exist in the chains.

Table 3. Links of the chain of pasteurized milk and its principal sub-processes.

Production	Collection	Processing	Marketing
Planning Nutrition Development Reproduction Milking process	Planning Collection and storage Transportation Delivering	Planning Exchange for the interrelations Milk reception Cooling Storage Clarification Homogenization Pasteurization Cooling Storage Bottled Storage in refrigerators Transportation and distribution Technological discipline	Planning Exchange for the interrelations Transportation Distribution.

In the production links the no state form predominates (98.8%); they are represented fundamentally by the Credit and Services Cooperatives. They group 94% of the producers and are characterized by having less than 20 cows (3,373 producer/87.2%). They are non-dairy cattle and provide 10⁴ liters/year of milk (Table 4). Producers do not use advanced technology in the production and the milking is mainly manual, so the university participate in their training when new technologies are introduced (García-Hernández et al., 2018).

Table 4. Actors' characterization of cattle milk production in Sancti Spiritus province (in percentage).

Criteria		n= 4560																
		No state sector									State sector							
Form of organization		98.8 ^a									1.2 ^b							
Volume of production ML/year		n=4505									n=55							
		High			Medium			Small			High		Medium		Small			
		5.2 ^c			8.9 ^b			85.9 ^a			40 ^a		14.5 ^b		45.5 ^a			
Cow in production (heads)		n=236			n=402			n=3867			n=22			n=8			n=25	
		High	Medium	Small	High	Medium	Small	High	Medium	Small	High	Medium	Small	High	Medium	Small	High	Medium

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93.6^a 2.1^b 4.2^b 9.4^b 79.1^a 11.4^b 9^b 3.8^c 87.2^a 90.9^a 5^b 5^b 75^a 25^b 0^c 28^b 72^a 0^c

Legend: Percentages on the same line with different superscript (a, b, c) are significantly different (P <0.05).

In the collection links (Table 5), they use different means of transportation, including animal traction (95.7%), to the cooling point, mostly for distances of 7 to 10 km (74.8%), with volumes of milk of more than 60 liters. The industry collection group has routes with isothermal cars, running distances between 80 -110 km, generally in four hours of duration.

Table 5. Actors' characterization of milk collection in the Sancti Spiritus province, Cuba (in percentage).

Means of transportation (n=236)	Animal traction 95.7 ^a		Motor car 4.3 ^b	
	n=226		n=10	
Destination	Direct at the point of sale	Cooling point	Direct at the point of sale	Cooling point
	25.2 ^b	74.8 ^a	40 ^a	60 ^a

Legend: Percentages on the same line with different superscript (a, b) are significantly different (P <0.05).

The methodology for planning had the starting point in the diagnosis of the initial situation of the chain of pasteurized milk in Sancti Spiritus. The SWOT Matrix (Strengths, Weaknesses, Opportunities and Threats) was constructed using a collective group, which provide evidences from the beginning of the chain. They identified initially 11 Strengths, 28 weaknesses, 18 opportunities and 13 threats. These were regrouped and in a second moment it allowed pondering the weaknesses.

Strengths: i) Existence of culture and cattle tradition backed by educational and sciences institutions with qualified human capital, ii) Good sanitary condition of the cattle bovine mass, iii) Different forms of management, iv) Quality of the human capital, v) Collection of the milk cold at 70 % and vi) Satisfactory sanitary hygiene of the milk tank.

Opportunities: i) The product is a national priority for feeding, mainly to children, pregnant women, and older adults, ii) Economic and social transformation in the country, iii) Opening to foreign investment in the agricultural sector, iv) Environmental conditions that favor the use of renewable sources of energy, v) Availability and storage of water for the lactic chain and vi) No satisfaction in the milk market at the province.

1) Weaknesses: i) Missuses of herd and incomplete zoo-technician cycle, ii) Insufficient alimentary base for the cattle exploitation, iii) Irrational use (use and handling) of the exclusive land for the bovine cattle, iv) Affectation in the quality of the milk in all links of the chain, v) Low quality of the raw milk produced and vi) Insufficient specialized transportation for milk collection.

Threats: i) There are not national policies for the integration of chains, ii) Marketing of raw milk, iii) The chain depends of external markets for some materials, iv) Risks for the climatic changes, v) The nonexistence of impartial laboratories and vi) Existence of better remunerated sectors

Different options were finally proposed for the discussion, but the six most popularly addressed for the plan of actions were the following:

1. Inadequate handling and nutrition of the cattle mass.
2. Inadequate sanitary quality and composition of the milk.
3. Inadequate practices in the process of collection for the industry, distribution and commercialization that affect the quality of milk.
4. Not advanced infrastructure, equipments and instruments in all the chain.
5. Insufficient offer and inadequate quality of the services.
6. The integration of all of the actors of the chain was weak, so interconnection between the linksph of the chain was evidently necessary.

One of the most appropriate techniques, under the topic of strategic planning is the technical analysis of strengths, weaknesses, opportunities and threats (SWOT) (Rafeeian & Taji, 2017). SWOT analysis supported the development of the plan action for the municipalities implicated in the agricultural chain of pasteurized milk at Sancti Spiritus, province, Cuba. The analysis result showed that the strategy for the development of chain in Sancti Spiritus is a SO strategy (Strengths - Opportunities). Those are summarized in Objectives, whit Strategic actions and proposals of actions that are not done today (Table 6).

Table 6. Summary of the plan of actions for the chain of the pasteurized milk at Sancti Spiritus province, Cuba.

Objective	Strategic actions	Indicators of change	Proposals of actions that are not done today
Achieving an efficient handling and nutrition of the cattle mass.	5	7	1
Improving the hygienic sanitary quality and composition of the raw milk.	7	8	5
Better standards of quality of the processes of collection, processing and distribution of milk.	4	4	0
Increasing the use of installed capacity, improving in the infrastructure, the technological equipment and instruments.	4	5	0
Improving of the offer in quantity and quality of the services and the raw materials for the production.	4	4	4
Better integral functioning of the chain.	9	5	2
Total	33	33	12

This situation raises another challenge for the dairy chains in many countries, related to the implementation of support programs destined to farmers (Sraïri et al., 2013, Soethoudt et al., 2018). This generates significant losses (Minten, Tamru and Reardon, 2021). In fact, with the huge numbers of non-specialized smallholder cattle farms, most of the farms are dispersed, so intervention is quite limited and suggests great defies (Armenteros-Amaya et al., 2020; Martínez et al., 2017).

CONCLUSIONS

The characterization of the actors of the pasteurized milk chain in four municipalities of Sancti Spiritus province showed that in the primary link with predominance of the non-state sector, but there is low milk production. For the collection of milk, they use animal traction and tanker trucks. Obsolete technologies and insufficient equipment are found in the processing link, while commercialization actors are limited by hygienic conditions. The comprehensive analysis of actors in the pasteurized milk chain in the province of Sancti Spíritus, Cuba, allowed to suggest for their development strategic objectives, intervention actions and indicators of change.

ACKNOWLEDGMENT

The authors thank all participants of the chain. A special recognition to the Agricultural Chain Project, to the Ministry of Agriculture in the province and to the different actors that took part in the development of this work. Also to Ph.D. Mercedes Fernández and M Sc. Yenima Martínez Castro for their contribution to the language revision of the paper.

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AUTHORS CONTRIBUTION

Conception and research design: JEHG, APPL, JANG, LPRA, OGB, MAGJ; data analysis and interpretation: JEHG, APPL, JANG, LPRA, OGB, MAGJ; article writing: JEHG, APPL, JANG, LPRA, OGB, MAGJ.

CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest.