Dairy goats fed sunflower hay intercropped with chickpea in small-scale systems. Part II: Cheese yield and composition, sensory analysis, and economic performance

Cabras lecheras alimentadas con heno de girasol intercalado con garbanzo en sistemas de pequeña escala. Parte II: Rendimiento y composición del queso, análisis sensorial y desempeño económico

Cabras leiteiras alimentadas com feno de girassol consorciado com grão de bico em sistemas de pequena escala. Parte II: Rendimento e composição do queijo, análise sensorial e desempenho econômico

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Abstract

Background: Goat production has grown worldwide as a way to improve the quality of rural life and reduce the environmental footprint; nevertheless, there is a need to increase productivity through improved feeding strategies. The market demands healthier products with organoleptic characteristics similar to the traditional ones; thus, it is necessary to evaluate the effect of new forages for goats and its acceptance by consumers. Chemical and organoleptic composition of goat milk vary according to the diet which, in turn, affects the characteristics of cheese. Cheese texture, taste and smell are the most important sensory attributes for consumers. **Objective:** To evaluate the effect of substituting corn straw with sunflower hay associated with chickpea for dairy goats on yield, chemical composition and sensory acceptability of cheese, as well profitability. **Methods:** Twenty-eight Saanen dairy goats were randomly assigned to two treatments in a 30-day experiment on a small farm. The daily ration per goat in the MZST treatment (control treatment) consisted of alfalfa hay (200 g/goat/day) and concentrate (400 g/goat/day) plus 600 g/goat/day (50% of the ration) of corn straw. The SFCP treatment substituted corn straw with sunflower-chickpea hay; it had the same alfalfa and concentrate content, but with no corn straw and was added with 600 g/goat/day of sunflower-chickpea hay. The yield, composition and sensory evaluation of fresh cheese made with milk from each treatment were recorded, and the feeding costs and returns evaluated. Variables for the chemical composition of cheese were analyzed following a completely randomized design. **Results:** Significant differences were observed in cheese yield and all chemical composition variables. According to sensory evaluation, SFCP cheese had significantly higher scores for texture and odor but lower for taste and overall acceptability compared to MZST. In terms of profitability, SFCP increased feed costs by 5% but resulted in higher margins over feed costs of 12 and 24% for milk and cheese, respectively, compared to MZST. **Conclusion:** In spite of favorable performance and economic returns of MZST treatment (control treatment), the organoleptic characteristics of the cheese reduced its general acceptance.

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Keywords: *alternative forages; dairy goats; economic performance; fresh cheese; milk; on-farm research; sensory analysis; small-scale livestock systems; sunflower-chickpea hay.*

Resumen

Antecedentes: La producción caprina a nivel mundial ha crecido como una forma de mejorar la calidad de vida rural y reducir la huella ambiental, pero existe la necesidad de aumentar la productividad a través de mejores estrategias de alimentación. La creciente demanda de los consumidores por productos más sanos pero con características organolépticas similares a los tradicionales, ha hecho necesario desarrollar estrategias para satisfacer esta necesidad, por lo que es necesario evaluar el efecto de los nuevos forrajes en las dietas sobre su aceptación por parte de los consumidores. La composición química y organoléptica de la leche de cabra varía según la dieta, lo que a su vez afecta las características del queso de leche de cabra. Entre los atributos sensoriales más importantes para los consumidores se encuentran la textura, el sabor y el olor. **Objetivo:** Evaluar el efecto de la sustitución de paja de maíz por heno de girasol con garbanzo en la alimentación de cabras lecheras, en términos de rendimiento, composición química y aceptabilidad sensorial del queso, así como desempeño económico. **Métodos:** Se asignaron al azar veintiocho cabras lecheras Saanen a dos tratamientos en un experimento de 30 días en una granja a pequeña escala. La ración diaria por cabra en el tratamiento MZST (tratamiento control) consistió en heno de alfalfa (200 g/cabra/día) y concentrado (400 g/cabra/día) más 600 g/cabra/día (50% de la ración) de paja de maíz. El tratamiento SFCP sustituyó la paja de maiz por heno de girasol-garbanzo; tuvo el mismo contenido de alfalfa y concentrado, pero sin paja de maiz y con 600 g/cabra/día de heno girasol-garbanzo. Se registró el rendimiento, composición y evaluación sensorial de los quesos frescos elaborados con leche de cada tratamiento y se evaluaron los costos de alimentación y los rendimientos. Las variables de composición química de los quesos se analizaron siguiendo un diseño completamente aleatorizado. **Resultados:** Hubo diferencias significativas para el rendimiento de queso y para todas las variables de composición química. De acuerdo a la evaluación sensorial, el queso SFCP obtuvo puntajes significativamente más altos en textura y olor, pero más bajos en sabor y aceptabilidad general en comparación con MZST. En términos económicos, SFCP aumentó los costos de alimentación en 5%, pero resultó en márgenes más altos sobre los costos de alimentación; de 12 y 24% para leche y queso, respectivamente, en comparación con MZST. **Conclusión:** A pesar del desempeño favorable y los beneficios económicos del tratamiento MZST (tratamiento control), las características organolépticas del queso reducen su aceptación general.

Palabras clave: *análisis sensorial; cabras lecheras; desempeño económico; forrajes alternativos; heno de girasol-garbanzo; investigación en finca; leche; queso fresco; sistemas de producción animal en pequeña escala.*

Resumo

Antecedentes: A produção de caprinos em todo o mundo tem crescido como forma de melhorar a qualidade de vida rural e reduzir a pegada ambiental; pero há uma necessidade de aumentar a produtividade através de estratégias de alimentação melhoradas. A crescente procura dos consumidores por produtos mais saudáveis mas com características organolépticas semelhantes aos tradicionais, tornou necessário desenvolver estratégias para satisfazer esta necessidade, pelo que é necessário avaliar o efeito de novas forrageiras nas dietas na sua aceitação pelos consumidores. A composição química e organoléptica do leite de cabra varia de acordo com a dieta, o que por sua vez afeta as características do queijo de leite de cabra. Entre os atributos sensoriais mais importantes para os consumidores estão textura, sabor e cheiro. **Objetivo:** Avaliar o efeito da substituição da palha de milho por feno de girassol associada ao grão-de-bico na alimentação de cabras leiteiras, em termos de rendimento, composição química e aceitabilidade sensorial do queijo, bem como desempenho econômico. **Métodos:** Vinte e oito cabras leiteiras Saanen foram distribuídas aleatoriamente em dois tratamentos em um experimento de 30 dias em uma fazenda de pequena escala. A ração diária por cabra no tratamento MZST (tratamento controle) consistia em feno de alfafa (200 g/cabra/dia) e concentrado (400 g/cabra/dia) mais 600 g/cabra/dia (50% da ração) de a palha de milho e o tratamento SFCP (tratamento substituiu o feno de girassol-grão moído) continham os mesmos teores de alfafa e concentrado, mas com 600 g/cabra/dia de feno de girassol-grão. O rendimento, a composição e a avaliação sensorial dos queijos in natura feitos com leite de cada tratamento foram registrados e os custos de alimentação e retornos avaliados. As variáveis de composição química dos queijos foram analisadas seguindo um delineamento inteiramente casualizado. **Resultados:** Houve diferenças significativas no rendimento do queijo e para todas as variáveis de composição química. A avaliação sensorial mostrou que o queijo SFCP teve pontuações significativamente mais altas para textura e odor, mas significativamente mais baixas para sabor e aceitabilidade geral em comparação com o MZST. Em termos econômicos, o SFCP aumentou os custos com alimentação em 5%, mas resultou em margens mais altas sobre os custos com alimentação de 12 e 24% para leite e queijo, respectivamente, em comparação com o MZST. **Conclusão:** Apesar do desempenho favorável e do retorno econômico com o tratamento MZST (tratamento controle), mudanças nas características organolépticas do queijo reduziram sua aceitação geral.

Palavras-chave: *análise sensorial; cabras leiteiras; feno de girassol-grão-de-bico; forragens alternativas; leite; performance econômica; pesquisa na fazenda; queijo fresco; sistemas de pecuária em pequena escala.*

Introduction

Livestock systems are key to ameliorating poverty in developing countries (FAO, 2010). Although goat production systems have been put forward as a means for sustainable livelihoods in rural communities around the world (Daskiran *et al.*, 2018) their productivity is generally low due to low quality and availability of feeds (Souza *et al.*, 2017). Improving goat feed can enhance productivity, which is required to improve livelihoods (Makkar, 2016). High quality forages may have a positive impact on milk yield (Cabral *et al.*, 2015) and, if home-grown, improve the efficiency of use of resources (Rao *et al.*, 2015).

Sunflower (*Helianthus annus*), which is native to Mexico, is rich in lipids (Rodrigues-Gandra *et al.*, 2017) and has been used to increase the fat content of diets. In goats, its use has resulted in increased milk protein content (Sanz-Sampelayo *et al.*, 2007). As an alternative forage source, it may improve diet quality and productivity of dairy goats; which also needs to be assessed in economic terms.

Goat milk composition varies according to diet, mainly in terms of milk fat and protein content which, in turn, affects the characteristics of cheese (Chilliard *et al.*, 2003; Sanz-Sampelayo *et al.*, 2007). Organoleptic characteristics of cheese may be affected by the forage fed to the animal, particularly in fresh cheese (Coulon *et al.*, 2004; Sanz-Sampelayo *et al.*, 2007). Therefore, the objective of this study was to evaluate the effect of substituting corn straw with sunflower hay plus chickpea for dairy goats in terms of yield, chemical composition and sensory acceptability of cheese, as well as profitability.

Materials and Methods

Ethical considerations

The experimental procedures with goats and work with the collaborating farmer followed guidelines accepted by Instituto de Ciencias Agropecuarias y Rurales (ICAR) of Universidad Autónoma del Estado de México and were institutionally approved (DICARN-1319).

Location of the study

An on-farm experiment following the participatory livestock technology development approach was undertaken in El Bajío region of central Mexico, located at 20° 12' 51" N and 100° 08' 19" W. El Bajío is the second-highest producer of goat milk in Mexico under semi-intensive and intensive systems.

Animals

A total of 28 dairy goats were randomly divided into two groups of 14 goats each (MZST and SFCP). Goats remained confined for the duration of the experiment in an open pen with a dirt floor, with water and a mineral and vitamin mix freely available at all times.

Diets

The MZST treatment was the conventional ration (as a control treatment) that included 200 g/goat/day of ground lucerne hay plus 400 g/goat/day of a concentrate with 18% CP prepared on the farm from a commercial concentrate with 22% CP (65% fresh weight), ground white corn grain (20% fresh weight), and ground sorghum grain (15% fresh weight). This diet had a roughage base of 600 g/goat/day of ground corn straw to produce 1.2 kg total on a fresh weight basis for the diet offered per goat.

The second treatment substituted corn straw with sunflower-chickpea ground hay (SFCP) at the same 600 g/goat/day as the forage base for this diet. Lucerne hay plus corn straw (MZST) or lucerne hay plus sunflower-chickpea hay (SFCP) were offered twice daily: half the ration in the morning and half in the afternoon. Lucerne hay and the treatment corn stover or sunflower-chickpea hay were provided separately but in the same trough as the lucerne hay. The concentrate was offered at milking.

This experiment was in the line of adaptive research – "an approach that characterizes the

needs of farmers and then uses experiments in farmers' fields to adapt a given technology to local conditions" (Flor *et al.*, 2017), thereby enabling more rapid dissemination and adoption of results (Stroup *et al.*, 1993).

Fresh cheese production

Experimental fresh cheese (white paste and pressed) was made by the collaborating farmer according to the usual practice in the study region. Milk was sieved and pasteurized at 75 °C and cooled to 35 °C when a commercial rennet (CUAMEX) was added. This mixture was left to set for 40 minutes, then cut into 1 cm cubes, and the whey removed. Salt at 20 g/L milk was added, the mass homogenized and placed in rings (500 g capacity), pressed (2.06 x 10^5 Pa) for 8 h and refrigerated at 4 °C for 24 h.

Chemical composition of cheese

Cheeses were weighed, a 500 g sample of cheese from each treatment was homogenized, and a 200 g subsample was kept at -20 °C until chemical analyses (Queiroga *et al.*, 2013) for moisture, ash, protein, fat, and pH (AOAC, 1990).

Sensory assessment

Cheese acceptability was assessed using a 1-to-5-point score, following Agudelo-López *et al.*, 2019) on a five-point scale test, as follows: 1: I do not like it; 2: I like it a little; 3: I do not like nor dislike; 4: I like it, and 5: I like it very much.

Cheese was cut into 2-cm cubes (approximately 20 g), randomly coded, placed on white plates (Kondyli *et al.*, 2016), and allowed to come to room temperature (18 ± 2 °C). Cheese was assessed in four sessions by 20 panelists (between 45 and 65 years of age) who were familiar with this type of cheese. Panel conformation followed methods described by Mehaia, 2002 and Moneeb *et al.*, 2019.

Cheese assessment followed the four phases described by Castro *et al.*, 2014: visual, mixed (touch and taste), olfactory, and mouth. Wheat bread and water were available for the panelists to cleanse their palates between tastings. The sensory appraisal was conducted in a white room at 21 to 23 °C, with artificial illumination, at noon time, on tables without divisions. The characteristics assessed were appearance, texture, color, flavor, odor, and overall acceptability, following Mehaia (2002).

Analysis of texture profile

The texture profile of cheese was assessed from 2 cm^3 cheese cubes using a texturometer (Stable Micro Systems, Godalming, Surrey, UK) with two cyclic compressions in a cylindrical steel probe (40 mm in diameter) at 2.0 mm/sec, with 4.0 mm rupture distance and 0.05 N force. The characteristics assessed were hardness, cohesiveness, adhesiveness (in Newtons), and elasticity (in mm) (Chen *et al.*, 1979).

Statistical analyses

ANOVA (Minitab 14 statistical software) was used to analyze the chemical composition variables of cheese following a completely randomized design with the following model:

$$Y_{ij} = \mu_i + t_j + e_{ij}$$

Where μ= general mean, t= effect of treatment (i = 1, 2) and e= residual variation. Mean comparisons among treatments were conducted with a Student "t" test.

ANOVA was also used for the sensory appraisal, as described by Mehaia (2002). Differences were significant at $p<0.05$.

Economic performance

Partial budgets were calculated for the duration of the experiment and used to determine costs and returns, considering only feed costs with results expressed in US dollars as previously reported (Prospero-Bernal *et al.* 2017). The variables used were the cost of ingredients to calculate total feed cost as well as total milk yield (from Sainz-Ramírez *et al.*, 2023) and cheese production. Total income and margin over feed costs were also calculated from the selling price.

Results

No statistical differences were found (p=0.215) between treatments in regard to milk fat used for the cheese, being 33.8 g/kg for MZST and 34.5 g/kg for SFCP; although there were differences (p<0.05) between treatments for protein (33.2 g/kg for MZST and 34.5 g/kg for SFCP; Sainz-Ramírez *et al.*, 2023).

The MZST diet contained 143.69 g crude protein/kg DM and 28.43 g ether extract (lipids)/kg DM, whilst the SFCPT diet contained 211.95 g crude protein/kg DM and 113.72 g ether extract/kg DM (Sainz-Ramírez *et al.*, 2023).

Cheese yield and chemical composition

Cheese yield (kg/10 kg milk) was significantly (p<0.001) higher for the experimental SFCP ration, with 12% greater yield (Table 1).

Moisture content was lower in cheese from the SFCP treatment; but protein, ash, and pH were significantly (p<0.05) higher in SFCP than the conventional MZST ration.

Texture profile

Cheese hardness in SFCP was almost 10% higher (p<0.05) than cheese from MZST, with no differences (p>0.05) for elasticity, cohesiveness, and adhesivity (Table 2).

Sensory appraisal of fresh goat-milk cheese

In terms of texture and odor, cheese from the SFCP had higher (p<0.05) scores than cheese from the MZST, but in terms of flavor and overall acceptance, cheese from MZST had higher (p<0.05) scores than cheese from the SFCP treatment (Table 3).

Economic performance

The feed item with the highest cost was the concentrate supplement, which represented nearly 60% of total feeding costs (Table 4).

Table 1. Fresh cheese yield and chemical composition.

	N	MZST	SFCP	SEM	P-value
Cheese yield (kg/10 kg milk)	30	1.25	1.40	0.07	0.001
Moisture (%)	30	55.21	54.89	0.03	0.001
Fat (%)	30	22.20	24.63	0.23	0.051
Protein (%)	30	22.84	24.85	0.28	0.001
Ash (%)	30	27.8	28.1	0.22	0.001
pH	30	5.67	5.80	0.16	0.001

MZST: Concentrate + Lucerne hay + Corn straw; SFCP: Concentrate + Lucerne hay + Sunflower-chickpea hay; SEM: Standard error of the mean.

Table 2. Sensory assessment of goat milk cheese.

Treatments	Hardness (N)	Elasticity (mm)	Cohesiveness (N)	Adhesivity (N)
MZST	19.22	0.82	0.71	-0.17
SFCP	21.04	0.84	0.74	-0.19
SEM	0.34	0.03	0.03	0.04
P- value	0.001	0.165	0.238	0.149

MZST: Concentrate + Lucerne hay + Corn straw; SFCP: Concentrate + Lucerne hay + Sunflower-chickpea hay; SEM: Standard error of the mean. N: Newton.

Table 3. Texture assessment of goat milk cheese.

	N	MZST	SFCP	SEM	P-value
Appearance		4.40	4.20	0.22	0.176
Texture	30	4.00	4.45	0.28	0.020
Color	30	4.25	4.40	0.20	0.324
Odor	30	2.85	3.20	0.27	0.019
Flavor	30	3.95	3.45	0.26	0.001
Overall acceptability	30	4.25	3.60	0.28	0.001

MZST: Concentrate + Lucerne hay + Corn straw; SFCP: Concentrate + Lucerne hay + Sunflower-chickpea hay; SEM: Standard error of the mean.

Table 4. Feeding costs and returns in US$ (unless otherwise stated) for the duration of the experiment.

Item	MZST	SFCP
Concentrate supplement	251.33	251.33
Lucerne hay	122.52	122.52
Corn Straw	51.84	0.00
Sunflower-chickpea hay	0.00	74.46
Total feeding cost	425.69	448.31
Milk production (kg)	407.40	449.4
Milk selling price (US$/kg)	1.59	1.59
Income from milk sales	647.56	714.32
Margin over feeding costs	221.88	266.01
Feeding costs/kg milk	1.04	1.00
Income/Feeding costs ratio	1.52	1.59
Cheese production costs	1,732.98	2,141.03
Cheese production (kg)	50.92	62.91
Cheese selling price (US$/kg)	41.14	41.14
Income from cheese sales	2,095.05	2,588.36
Margin over production costs of cheese	362.08	447.33

MZST: Concentrate + Lucerne hay + Corn straw; SFCP: Concentrate + Lucerne hay + Sunflower-chickpea hay.

Sunflower-chickpea hay was 30% more expensive than corn straw, but once included in rations SFCP ration was only 5% more expensive than the MZST ration since the cost of the base forage is diluted given the high cost of the concentrate supplement.

This was offset by the higher milk yields in the SFCP treatment, which generated 10% higher income from milk sales, representing 20% higher margin over feeding costs.

Regarding cheese, the SFCP treatment resulted in 24% higher cheese production, resulting in a similar 24% higher income and margin over feeding costs compared to the conventional MZST ration.

Discussion

Feeding dairy goats with hay obtained from sunflower intercropped with chickpea led to higher animal performance compared to the conventional diet based on corn straw,

highlighting the prospects for improving productivity of these systems as put forward by Rao *et al.* (2015) and Makkar (2016).

Yield and chemical composition of fresh goat cheese

Chemical composition of cheese in terms of fat, protein and ash was similar to reports by Ramírez-Lopez and Vélez-Ruiz (2016), Acevedo *et al.* (2018), Santos-Lavelle *et al.* (2018), and Pedregosa-Cabrero *et al.* (2020) for fresh cheese from goat milk.

The high energy supply provided by the SFCP treatment increases microbial protein synthesis and propionate concentration in the rumen resulting in increased milk yield and protein content as reported by Hills *et al.* (2015) and Vicente *et al.* (2017), when including high-energy diets in dairy cows. High protein content in milk allows for greater K-casein hydrolysis, which increases the production of para-K-casein micelles and macro-peptides that, combined with calcium ions, produce a strong union between micelles and increase cheese yield (Guinee *et al.*, 2006).

Fat and moisture content have an inverse relationship since low fat contents result in high water retention capacity (Kondyli *et al.*, 2016). These effects were observed in the present study, despite the lack of maturity of cheese. Milk fat and protein also affect cheese pH since casein micelles increase the buffer capacity of milk (Deshwal *et al.*, 2020); the pH of cheeses made with treatment SFCP was higher.

Texture profile

Texture in cheese is related to hardness and moisture content, which may be affected by milk composition and, eventually, by diet composition. Low moisture content in cheese results in high hardness (Queiroga *et al.*, 2013). In the work herein reported, the SFCP treatment resulted in higher hardness score of cheese. On the other hand, fat content contributes to the development of aromas and flavors and does affect texture and color (Guinee y McSweeney, 2006). The high fat content of the SFCP cheese resulted in significant effects on these parameters. Acevedo *et al.* (2018) and Pedregosa-Cabrero *et al.* (2020) mentioned that low fat content in cheese reduces adhesivity, while high elasticity is obtained by high protein content.

Sensory appraisal of cheese

Delgado *et al.* (2011) mentioned that flavor in cheese depends on the lactose and lactate contents, the extent of lipolysis and proteolysis within the cheese; in cheese from goat milk, flavor is strongly related to the presence of ramified chain fatty acids. The lipolytic system in goat milk is specific and may be altered by dietary fat supplementation, where liberation of certain fatty acids may generate unpleasant flavors in cheese, such as rancid or oxidized flavors that are linked to lipolysis or bitter notes linked to proteolysis, particularly in fresh cheese (Raynal-Ljutovac *et al.*, 2011). This situation was observed in the present study, where the SFCP treatment had four times higher lipid content than the MZST treatment (113.72 vs 28.43 ether extract g/kg DM), which might have affected the variables of sensory attributes assessed in cheese.

Changes in milk fat content may affect lipid oxidation in cheese, which affects acceptability and quality of dairy products (Mlambo and Mapiye, 2015). There was no significant difference ($p=0.051$) in the cheese fat content between treatments; however, the numerical increase in fat could have resulted in the observed differences in flavor and overall acceptability of cheese from MZST and SFCP.

In terms of pH, cheese from goat milk tends to be alkaline and has high buffering capacity compared to cheese from cow milk, particularly in fresh cheeses (Galina *et al.*, 2007) where pH has a strong effect on cheese flavor, which is more intense as pH approaches 6.0 or higher (Sanz-Ceballos *et al.*, 2009). In the present study, cheese pH values were below 6.0, which are adequate for fresh cheese. However, cheese from SFCP had a lower rating for flavor. Some

research (Freitas and Malcata, 2000; Watkinson *et al.*, 2001; Queiroga *et al.*, 2013) has suggested that high acidity in cheese generates changes in cheese proteins and, therefore, in texture, resulting in softer cheese. In the present study, low pH and texture scores were found in MZST cheese.

Economic performance

Use of concentrates in dairy operations substantially increases feeding costs, making farms economically more vulnerable (Hanrahan *et al.*, 2018). Therefore, determining feeding costs helps to identify the vulnerability of farms and influences decision-making (Hemme *et al.* 2014). In our experiment, the concentrate supplement represented the most expensive item in feeding costs. The slightly higher feeding cost of SFCP treatment was more than offset by the increased production, incomes and margins over feeding costs compared with the conventional MZST ration.

Rao *et al.* (2015), Makkar (2016), and Shikuku *et al.* (2016), among other researchers, have mentioned that permanence of farms relies on their capability to develop profitable feeding strategies that enhance productivity, with improved quality forages a key aspect. The experimental SFCP ration based on sunflower-chickpea hay meets that premise, being profitable and viable, as results have shown.

In conclusion, our results show that feeding dairy goats with a SFCP ration based on sunflower hay and chickpea has an effect on cheese composition, modifies its texture profile, and affects consumer acceptance. Cheese produced with SFCP has higher protein and ash content and better texture, smell and taste compared with MZST. Additionally, the SFCP treatment increased income from milk and cheese sale and, therefore, profit margins on feed costs compared to a conventional MZST diet based on corn straw.

Declarations

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Conflict of interest

The authors declare they have no conflicts of interest with regard to the work presented in this report.

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Author contributions

Aurora Sainz-Ramírez: research, laboratory analyses, writing—original draft. José Velarde-Guillén: methodology, writing—review and editing. Julieta Gertrudis Estrada-Flores: methodology, writing—review and editing. Felipe López Gonzalez: methodology, writing—review and editing. Carlos Manuel Arriaga-Jordán: conceptualization, resources, writing—review, editing and translation, supervision, funding acquisition.

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