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Development sensory and nutritional analyses of sweet pearl ice cream

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Abstract---Ice cream is a well-known delicacy. This study's purpose was to make ice cream from the sweet pearl F1 cultivar using three degrees of maize starch. It was developed by a group of BTLED lecturers from the College of Education to empower young people to spread technology and livelihood education in rural areas. As an agricultural country, farmers are vital to our economy. As a result, we must carefully distribute livelihood education among our corn families. This study's goal was to create three ice cream flavors and evaluate their nutritional value and appeal. The study found that the flavor and color criteria for evaluating ice cream did not change significantly among the three treatments studied. ANOVA found significant differences in ice cream texture and palatability between treatments. Only T3 exceeded the USDA's 10% fat guideline, according to nutritional study. The three varied amounts of starch did not create a significant difference in taste or color, but they did in texture and palatability. The researchers suggest using one teaspoon (T3) commercial corn starch and a fat content of no more than 10% to ensure superb taste and texture. Studying ice cream's melting ability after it hardens in the ice cream machine is also advised.

Keywords---Sweet Pearl F1, nutritional analysis, ice cream, palatability, texture, flavor.

Introduction

The Bachelor of Technology and Livelihood Education (BTLEd) program prepares young adults to be the driving force behind the dissemination of technology and livelihood education in rural areas. Farmers are at the forefront of our economy since we are an agricultural country. As a result, we must pay close attention to livelihood education among our corn-growing households. According to the Department of Agriculture's annual report for 2018, the country's corn production reached 7,771,918.6 metric tons (MT). The Cagayan Valley supplied nearly 21% of the total volume of this collection. A local farmer in Gattaran, however, stated that some farmers have abandoned their standing corn fields without harvesting the corn ear since the purchasing price of corn grains has fallen to such a low level that it no longer compensates them for the effort of harvesting. The actions of corn household members in the field are also seasonal in nature. As a result, there is significantly more slack time than productive time. It is for this reason that some of the family's time should be diverted to corn processing activities such as, but not limited to, ice cream making. Despite the fact that ice cream is already well-known to the general public, it is necessary to reexamine the raw material sources in order to make it more competitive in terms of price and nutritional quality.

Ice cream, which is composed of small air cells scattered in a partially frozen, continuous aqueous phase, has a high nutritional value because of its high nutritious content. The necessary quality is accomplished by the right processing and formulation of the various elements, as well as their combination. Goff and Hartel are two of the most successful entrepreneurs in the world (2013). 1 Corn syrup is an essential ingredient in the production of ice cream. The term "corn syrup" refers to what is technically known as "glucose syrup" or "corn starch hydrolysate syrup" in the industry. Corn syrups are classed according to their dextrose equivalency (DE), which shows the degree to which the starch in the syrup has been hydrolyzed to provide dextrose. Once total conversion is performed with a DE of 100, the sweeter the corn syrup will be as a result of the higher DE. Ice cream manufacturers, on the other hand, often employed a liquid or dry corn syrup product with a DE of 28 to 42. Goff and Hartel are two of the most successful entrepreneurs in the world (2013).

Notably, the usage of maize, specifically the sweet pearl white corn (F1) variety grown in the region, would be increased through the use of this technique. It also provides the option for product diversification, which results in increased income for both farmers and their families. Technology will be developed to produce an optimal maize (white corn /f1) ice cream preparation process that may be adopted by micro-, small and medium-sized enterprises (MSMEs), local government units (LGUs), and even existing ice cream manufacturers in the region. This technology will also allow for the production of safe, nutritious, and acceptable ice cream items that are entirely natural and will be offered to consumers who enjoy sweets or desserts.

Objectives of the study

This research was conducted with the goal of developing and testing corn ice cream in general terms. This study aims to do the following:

- a. Formulate an ice cream product
- b. Determine the nutritional content of the processed ice cream and
- c. Determine the acceptance of the product by conducting sensory evaluation.

Statement of the Null Hypothesis

There is no significant difference on the effect of starch content of the different treatments in terms of taste, texture, color and palatability.

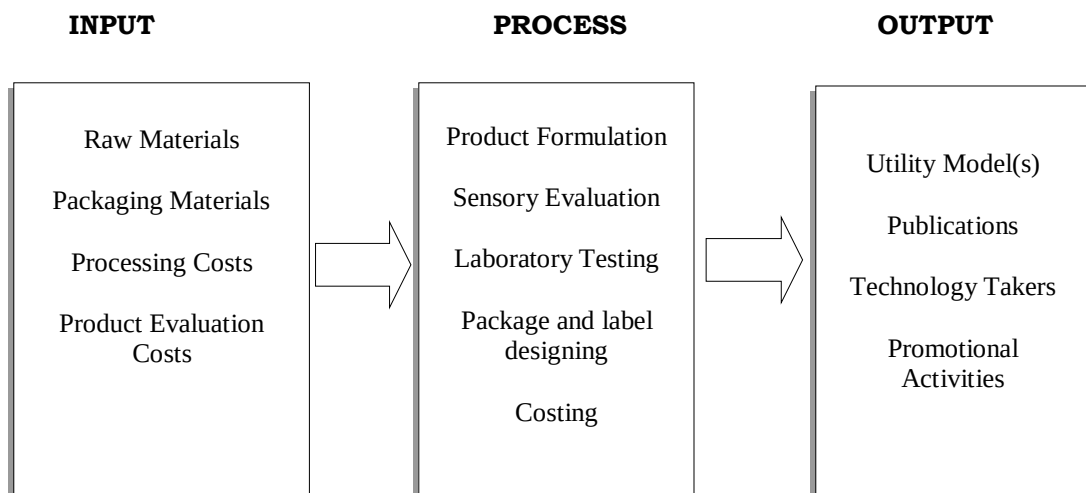
Related Literature

Corn, scientifically known as *Zea mays* Linn, is one of the secondary crops grown in the Cagayan Valley. Corn output is crucial since corn farming is the principal source of income for many farmers in the United States. There are numerous advantages to eating corn ice cream. Because of the absence of a well-established and effective corn ice cream process in the area, producers are limited in their ability to deliver a wide selection of products to both local and international clients. White Sweet Pearl F1 is a very rare hybrid white maize variety that is waxy and sweet, has milky white kernels, and has a high amylose content (a type of sugar). It is an early maturing cultivar that matures in 60-65 days. Because of its high drought tolerance, it is particularly well suited for planting during the summer dry season.

According to the United States Federal Regulations, ice cream is defined as a frozen product manufactured from a mix of dairy components that contains at least 10 percent milk fat (Marshall and others 2003) before the addition of bulk additives such as flavorings and sweeteners (21CFR135.110). Furthermore, according to AM Abd El-Rahman et al. (1997), the viscosity of ice cream mixes is modified by the supply of milk fat as well as the addition of an emulsifier to the mix. Ice has distinct textural qualities (Syed QA, et al.) The following four elements are the most important factors impacting the product's commercial success. Furthermore, the particle size distribution of fat globules, the melting resistance, and the amount of proteins in the aqueous phase of ice creams are all measured in the laboratory (Granger C. 2004). According to Koxholt and colleagues (2006)6, the pace of meltdown is dependent on the size of fat agglomerates in the unfrozen serum phase (M.M.R. Koxholt et al. 20016). As previously stated by Buyck JR et al (2011), increasing the temperature of the storage freezer as a means of reducing energy consumption has the potential to minimize ice cream production costs. They also observed that stabilizers and emulsifiers improve the smoothness of ice cream by raising viscosity and restricting the mobility of free water molecules in the ice cream. Despite this, their excess may result in lower melting and whipping capabilities for some recipes. Sugar imparts a sweet flavor to ice cream while also increasing its thickness and bulkiness. However, if the solid percentage of the ice cream surpasses 42 percent, too much sugar might cause it to become mushy.

Ice cream must include fewer than 10% milkfat and 20% total milk solids in order to comply with US regulatory regulations, according to Arbuckle (2000, 2008). More than 0.5 percent stabilizers and fewer than 1.6 pounds of total food solids per gallon are both prohibited for use in this product. In an outstanding average ice cream, fat accounts for 12 percent of the total, milk solids nonfat (MSNF) accounts for 11 percent, sugar accounts for 15 percent, stabilizers and emulsifiers account for 0.3 percent, and total solids (TS) accounts for 38.3 percent. Due to the fact that stabilizers increase water binding capacity, they have no effect on the taste or the value of the product. Additional stabilizing agents are used to smooth the texture of ice cream, boost viscosity, and provide resistance to melting. Furthermore, the nature and quantity of the flavor compound, as well as the availability of the flavor compound to the sensory system as a function of time (Li Z. 1997), influence the perception of flavor.

Conceptual framework



Methods and Procedures

Materials

The materials used in this study were corn grits (hard dough stage) of sweet pearl (F1), whole milk, heavy cream, vanilla extract; sweetener table salt; and commercial corn starch.

Experimental Procedures

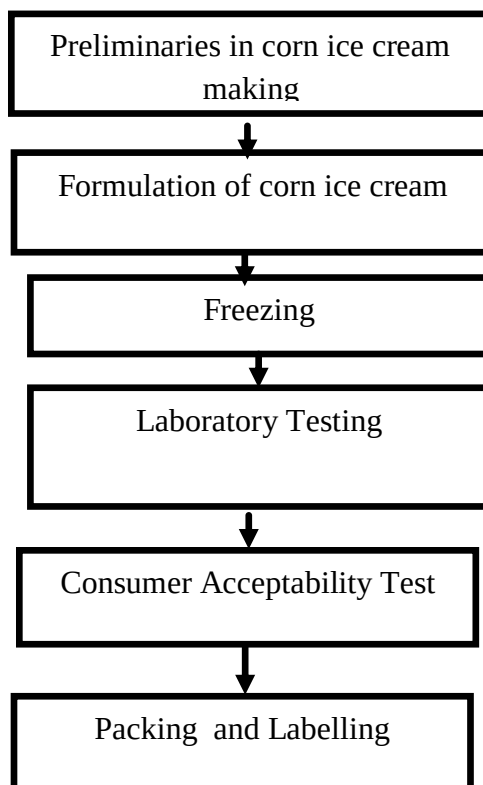


Figure 1. Flowchart of corn ice cream

Preliminaries in corn ice cream making

The basic ingredients were obtained at the public market in the neighborhood. The corn, on the other hand, was procured from Alcala since it was of the desired sort. The remaining materials and ingredients were arranged in the order of the desired quantities. Various pre-treatment activities, including as grinding, crushing, and pressing, were carried out in order to aid the extraction of corn's aroma and the extraction of the maximum amount of starch. Cheesecloth filtering was used to remove suspended particles from corn juice after it had been heated. This prevents the inclusion of extraneous particles in the treatments, which would otherwise detract from the desired texture.

Formulation of Corn Ice Cream

Aside from corn starch, the following ingredients were utilized in the product formulation at a constant level: the desired level of corn kernels (sweet pearl-F1), full milk, heavy cream, vanilla extract, sweetener, and table salt, to mention a few. Three formulations were created and each was submitted to a sensory evaluation using characteristics that were consistent across the three formulations

Consumer acceptability test or sensory analysis

Taste, texture, palatability, and color are some of the physical criteria to consider. The fifteen panels of evaluators were divided into three groups in order to evaluate the three therapy options. Each cluster analyzed the three treatment formulations and carried out three evaluations per treatment in their respective clusters. The level of each quality, namely taste, texture, palatability, and color, was determined using a 10-point hedonic scale, with 10 being the best. The sensory evaluation rubrics are provided in the next section.

Criteria	Unsatisfactory (1)	Fairly Satisfactory (2)	Satisfactory (3)	Very Satisfactory (4)
Taste	Ice cream tastes bland	Ice cream is too sweet	Ice cream is delicately sweet but sugary	Delicately sweet, with a well-balanced taste of corn.
Texture	Very rough and watery	Slightly rough and dry with few granular particulates.	Ice cream is fine and smooth with few granular particulates.	Ice cream is fine, smooth and firm.
Palatability	Poor blend of corn with other ingredients	Refreshing blend of corn but with dominant flavor of cream.	Refreshing blend of ingredients but with only a partial corn flavor.	Refreshing blend with a dominant taste of corn
Color	Color combination used was pale/weak. It is not appropriate for the corn flavor.	Color combination used was pale/weak. It does not harmonize with corn flavor.	Color combination used was quite pleasing and in harmony with the corn flavor.	Color combination was pleasing and in harmony with the corn flavor.

Laboratory testing

Treatments that are properly packed were submitted to FAST laboratory in Quezon City for Nutritional Analysis.

Packaging and labeling

The developed products were packed in cups and labeled following the FDA label requirements in the containers.

Statistical tool

The rubrics served as a source of raw data for the analysis. The mean calculated from the score sheet was utilized to process the data, which was then analyzed using the One-Way ANOVA method (Analysis of Variance). In order to examine the degree of significance across treatments at 1 percent and 5 percent level of

significance, we employed F-computed and F-tabular values, which were calculated and tabulated.

Results

The results of a sensory evaluation of the ice cream's taste parameter are shown in Table 1 below. When a mean of 3.27 is reached, it is considered satisfactory, while a mean of 3.67 is considered virtually very satisfactory. To put it another way, the action of starch in the formulation produced a result that was more than satisfying to the consumer. It was revealed in Table 1a that treatments were not substantially different from one another when the ANOVA was used to analyze the data. The varying amount of starch used, ranging from 14 teaspoons to 1 teaspoon, did not produce a significant change in flavor amongst the treatments evaluated.

Table 1
Result of sensory evaluation as to Taste among the treatments

Treatment	Replication			TOTAL	MEAN
	I	II	III		
T1	3.4	3.0	3.4	9.8	3.27
T2	3.4	3.0	3.4	9.8	3.27
T3	3.4	3.6	4.0	11.0	3.67
Grand Total				30.6	
Grand Mean					3.403

Table 1a.
ANOVA Table for Taste

Sources of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F-Comp	Tabular -F	
					1%	5%
Treatment	t-1	0.32	0.16	0.281 ^{n.s.}	5.14	10.92
Experimental Error	t(r-1)	3.4	0.57			

Treatments ^{n.s.}

The results of the sensory evaluation of the ice cream's texture parameter are shown in Table 2 of this report. The achieved mean of 3.27 and 3.20 is approximately satisfactory, whereas the acquired mean of 3.47 is nearly extremely satisfactory. For want of a better expression, the three amounts of starch used in the formulation produced a good result for the consumer. Furthermore, as indicated in Table 2a, an analysis of variance demonstrates that the treatments showed a highly significant difference from one another. When comparing the one teaspoon level of starch to the other treatments, there was a significant difference in terms of textural difference. According to the findings of Syed et al., the textural characteristics of ice cream are the most important aspects determining the product's sales success on the market. As a result, we can fairly conclude that

T1 and T2 did not produce results that were equivalent to T3. As a result, one teaspoon is extremely advantageous when compared to the other treatments.

Table 2
Result of sensory evaluation as to Texture among the treatments

Treatment	Replication			TOTAL	MEAN
	I	II	III		
T1	3.4	3.4	3.0	9.8	3.27
T2	3.4	3.2	3.0	9.6	3.20
T3	3.6	3.4	3.4	10.40	3.47
Grand Total				29.80	
Grand Mean					3.313

Table 2a.
ANOVA Table for Texture

Sources of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F-Comp	Tabular -F	
					1%	5%
Treatment	t-1	0.70	0.35	12.96**	5.14	10.92
Experimental Error	t(r-1)	0.16	0.027			

*Treatments**.*

The results of a sensory evaluation of the color parameter of ice cream are shown in Table 3 below. The mean of 3.27, 3.27, and 3.67 was reached, and it was rated as "more than satisfactory." To put it another way, the action of starch in the formulation produced a result that was more than satisfying to the consumer. However, according to the results of the ANOVA shown in Table 3a, the treatments were not statistically substantially different from one another. The three different amounts of starch used did not produce a significant change in color amongst the treatments that were evaluated. Nonetheless, the color scheme chosen was rather appealing and in harmony with the maize flavor, as evidenced by the rubrics on the packaging.

Table 3
Result of sensory evaluation as to *Color* among the treatments

Treatment	Replication			TOTAL	MEAN
	I	II	III		
T1	3.4	3.0	3.4	9.8	3.27
T2	3.4	3.0	3.4	9.8	3.27
T3	3.4	3.6	4.0	11.0	3.67
Grand Total				30.6	
Grand Mean					3.403

Table 3a.
ANOVA Table for Color Test

Sources of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F-Comp	Tabular -F 5% 1%	
Treatment	t-1	0.32	0.16	0.281 ^{n.s.}	5.14	10.92
Experimental Error	t(r-1)	3.4	0.57			

Treatments^{n.s.}

The results of the sensory evaluation of the palatability parameter of ice cream are presented in Table 4. The mean acquired from 3.13 and 3.07 is less than satisfactory, however the mean obtained from 3.87 is almost completely satisfactory. If you look at the rubrics, the effect of starch in the formulation produced more than a refreshing blend of ingredients, but just a partial corn flavor, which was observed by the consumer. Furthermore, as indicated in Table 4a, the results of the ANOVA revealed that there was a highly significant difference between the treatments that were evaluated. There was a highly significant difference in terms of palatability between the treatments studied when the amount of starch (as a stabilizer) was altered. As a result, the general palatability of T3 in comparison to the other therapies was extremely favorable. The findings are consistent with the assertion made by Syed et al. that stabilizers increase the viscosity of ice cream as it enters the palate of the taster or evaluator (Syed et al., 2003).

Table 4
Result of sensory evaluation as to Palatability among the treatments

Treatment	Replication			TOTAL	MEAN
	I	II	III		
T1	3.0	3.0	3.4	9.4	3.13
T2	3.0	3.2	3.0	9.2	3.07
T3	3.6	4.0	4.0	11.6	3.87
Grand Total				30.20	
Grand Mean					3.357

Table 4a.
ANOVA Table for Palatability Test

Sources of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F-Comp	Tabular -F 5% 1%	
Treatment	t-1	01.18	0.59	14.75 ^{**}	5.14	10.92
Experimental Error	t(r-1)	0.24	0.04			

*Treatments^{**}*

Treatment three (T3) had a fat content of 8.56 percent, which is much lower than the fat contents of Treatments two and one (T2). The findings are consistent with the recommended level of fats in the United States Federal Regulations of not more than 10%, as stated by Marshall et al (2003). The values for the other parameters were higher than the recommended values. T3 had the lowest sugar concentration among the treatments, with 18.8 percent of the total sugar amount. Although this is a little more than the 15 percent advised by Arbuckle (2000), it is still a reasonable estimate (2000). Nonetheless, this nutritional content could be controlled during packaging in order to ensure that the consumer receives the appropriate daily allowance for their body.

Table 5
Laboratory result on the nutritional quality of corn Ice cream as analyzed by
FASTLAB, Quezon City, Manila. May 2021

Parameters	Results		
	Treatment 1	Treatment 2	Treatment 3
Moisture	57.2	55.7	57.5
Ash	0.823	0.756	0.712
Fat	13.4	11.4	8.56
Protein	2.72	2.01	2.93
Carbohydrates	25.9	30.1	30.3
Calories	235	231	210
Total sugar	20.0	19.2	18.8
Total dietary fiber	5.17	5.08	3.65

Discussion of Findings

The outcome of a sensory evaluation of the ice cream's taste parameter was published. When a mean of 3.27 is reached, it is considered satisfactory, while a mean of 3.67 is considered virtually very satisfactory. To put it another way, the action of starch in the formulation produced a result that was more than satisfying to the consumer. It was revealed in Table 1a that treatments were not substantially different from one another when the ANOVA was used to analyze the data. The varying amount of starch used, ranging from 14 teaspoons to 1 teaspoon, did not produce a significant change in flavor amongst the treatments evaluated.

The outcome of the sensory evaluation of the ice cream's texture parameter is shown below. The achieved mean of 3.27 and 3.20 is approximately satisfactory, whereas the acquired mean of 3.47 is nearly extremely satisfactory. For want of a better expression, the three amounts of starch used in the formulation produced a good result for the consumer. Furthermore, as indicated in Table 2a, an analysis of variance demonstrates that the treatments showed a highly significant difference from one another. When comparing the one teaspoon level of starch to the other treatments, there was a significant difference in terms of textural difference. According to the findings of Syed et al., the textural characteristics of ice cream are the most important aspects determining the product's sales success on the market. As a result, we can fairly conclude that T1 and T2 did not produce

results that were equivalent to T3. As a result, one teaspoon is extremely advantageous when compared to the other treatments.

Sensory study of the ice cream's hue parameter yielded the following result: It was regarded as more than adequate by the mean of 3.27, 3.20, and 3.47, which was acquired. To put it another way, the action of starch in the formulation produced a result that was more than satisfying to the consumer. However, according to the results of the ANOVA shown in Table 3a, the treatments were not statistically substantially different from one another. The three different amounts of starch used did not produce a significant change in color amongst the treatments that were evaluated. Nonetheless, the color scheme chosen was rather appealing and in harmony with the maize flavor, as evidenced by the rubrics on the packaging.

The outcome of a sensory evaluation of the ice cream's palatability parameter was reported. The mean acquired from 3.13 and 3.07 is less than satisfactory, however the mean obtained from 3.87 is almost completely satisfactory. If you look at the rubrics, the effect of starch in the formulation produced more than a refreshing blend of ingredients, but just a partial corn flavor, which was observed by the consumer. Furthermore, as indicated in Table 4a, the results of the ANOVA revealed that there was a highly significant difference between the treatments that were evaluated. There was a highly significant difference in terms of palatability between the treatments studied when the amount of starch (as a stabilizer) was altered. As a result, the general palatability of T3 in comparison to the other therapies was extremely favorable. A connection between these discoveries and stabilizing agents is that stabilizing agents increase viscosity of ice cream as it approaches the taster or evaluator's palate³.

Treatment three (T3) had a fat content of 8.56 percent, which is significantly lower than the fat contents of Treatments two and one. The findings are consistent with the required level of fats in the United States Federal Regulations of not more than 10%². The values for the other parameters were higher than the recommended values. T3 had the lowest sugar concentration among the treatments, with 18.8 percent of the total sugar amount. It should be noted, however, that this percentage is little greater than 15%⁴. Nonetheless, this nutritional content could be controlled during packaging in order to ensure that the consumer receives the appropriate daily allowance for their body.

Conclusions

The study therefore closes that the;

1. Three levels of starch did not give any substantial difference in terms of taste and color among the treatments tested;
2. The three levels of starch gave highly significant difference in terms of texture and palatability among the treatments tested; and
3. Treatment three (T3) surpassed the USDA recommendation of not more than 10% fat.

Recommendation

Based on the above findings of the study, the researchers recommend:

1. The use of one teaspoon (T3) commercial corn starch to ensure good results on palatability and texture; and
2. The use of treatment 3 (T3) due to its ideal level of nutritional analysis for fats in terms of recommended value.
3. Further study on the melting ability as it hardens in the ice cream maker.
4. More flavors or variants may be tested for nutritional value

Economic/ financial implications

In today's market, there are numerous culinary innovations available. In order to become the best in town, culinary scientists are obsessively focused on discovering cuisine trends that appeal to both elderly and young people (food trends). On the market, there are many different varieties of deserts to choose from, but the nutritional value of these meals is very significant to customers. As one of their favorite meals, people enjoy ice cream as well. While there are a variety of commercial ice creams available on the market, this research focuses on the palatability and nutritional value of its sources without compromising the overall quality of the ice cream. Many food grabbers would take advantage of this type of business because of the economic aid it provides, which would result in the company's owners reaping economic or financial rewards as well. Economic stability or financial independence will result from the presence of additional companies like this. In the same way, informed consumers would be able to purchase products that are both high in nutritious value and fairly priced.

According to Karaman et al (2014), 10 Ice cream manufacturers have a wide range of possibilities for customizing the content, ingredients, form and quality of their products, as well as the packaging. Having such a varied range of ingredients and techniques at one's disposal, the potential for crafting a plethora of delightful frozen desserts is virtually unlimited.

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Conflict of interest:

The authors declare no conflicts of interest in preparing this article.

Authors' contribution:

Dr. Alfiler designed and conducted the study, and prepared the manuscript with important intellectual input from Dr. Natividad and Dr. Rodriguez. Cagayan State University provided funding for the study, statistical support in analyzing the data with input from Dr. Alfiler. We would like to thank Dr. Alma Manera for her editorial support during the publication of the study.

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