Characterization of colonial cheese: appreciation a traditional product from southern Brazil

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ABSTRACT: South Brazil produces colonial cheese based on Italian immigration recipes. This study characterized colonial cheese produced in the state of Rio Grande do Sul. The sampling method was by conglomerate. A total of 293 rural producers were interviewed; they also provided cheeses for physicochemical and microbiologicanalyses. For the characterization of colonial cheese, parameters related to milk, processes, social aspects, physical aspects and ingredients were selected and cluster analysis was performed. Results showed that the colonial cheese is made with whole milk, rennet and salt, with a round shape, weighing an average of 1.22 kg, with an average maturation of 9.4 days, high moisture, fat, using raw or pasteurized milk. The recipe is familiar, passed down through generations and the sale is made directly to the consumer.
Key words: artisanal food, rural development, raw milk, familiar agribusiness.

Caracterização do queijo colonial: valorização de um produto tradicional do Sul do Brasil

RESUMO: O Sul do Brasil produz queijo colonial com base nas receitas da imigração italiana. O objetivo deste estudo foi promover a valorização do queijo colonial produzido no estado do Rio Grande do Sul, por meio de sua caracterização. O método de amostragem foi por conglomerado. Foram entrevistados 293 produtores rurais; também forneceram queijos para análises físico-químicas. Para a caracterização do queijo colonial, foram selecionados parâmetros relacionados ao leite, processos, aspectos sociais, aspectos físicos e ingredientes e realizada análise de agrupamento. Os resultados mostram que o queijo colonial é feito com leite integral, coalho e sal, de formato redondo, pesando em média 1,22 kg, com maturação média de 9,4 dias, de alta umidade, gordo, utilizando leite cru ou pasteurizado. A receita é familiar, passada de geração em geração e a venda é feita diretamente ao consumidor.
Palavras-chave: alimentos artesanais, desenvolvimento rural, leite cru, cultura alimentar.

INTRODUCTION

Traditional cheeses are products that carry local identity, as the natural resources and knowledge involved in their production are the result of history and the differentiation of agrarian systems over time. They make use of a complex sequence of natural and technical resources, which is why the sensory characteristics of traditional cheeses are considered as the heritage mark of a territory (LINK et al., 2006).

The cheese produced in southern Brazil, called "Colonial", is related to Italian immigration, which took place at the end of the 19th century, and brought with it the recipe and the habit of producing the cheese, then called "*formaggio*". Initially, colonial cheese was produced with raw milk, produced on the rural properties and made by women for family consumption. The surplus was used to exchange for other goods in local markets (AMBROSINI et al., 2020a; CARVALHO et al., 2016; DE MEDEIROS CARVALHO et al., 2019; KAMIMURA et al., 2019).

Over time, cheese became known colonial, relating the cheese to the place where it was produced, that is, on immigrant properties located in the "colonies". Commercialization began via informal sales to family and neighbors, and then expanded to include agro-industries formalized industries that introduced pasteurization (AMBROSINI et al., 2020a).

Currently, colonial cheese is produced both by families for their own consumption and/ or for informal sale, as well as by small, medium and large dairy companies. Generally, following

tradition, families carry out the processing of colonial cheese with raw and self-produced milk, whereas the companies use pasteurized milk purchased from third parties (AMBROSINI et al., 2020a).

Evaluating and characterizing a cheese involves several parameters, from physicochemical and microbiological parameters to historical and social aspects of its production. This assessment becomes more complex when we deal with artisan cheeses, which have their characteristics closely linked to biodiversity and which have a variability in their characteristics, due to their small-scale production process, with a predominance of manual techniques, based on the unique human experience, and not in automated technology, and subject to changes in the milk itself, according to the season, breed and a diet of the animals, for example (BERGAMASCHI et al., 2020; LEKSIR et al., 2019).

Although, the production of colonial cheese is part of the food culture in southern Brazil and has great socio-economic importance, there are still few studies that address its characterization, taking into account the physicochemical, microbiological, technological, sensory and social aspects. Most studies are punctual, use small samples and only assess hygienic-sanitary conditions (SILVEIRA JÚNIOR, 2012; ZAFFARI, 2007). The characterization of historical products, which are still produced by hand, becomes important as many of them run the risk of disappearing due to rural exodus and changes in eating habits (LEKSIR, 2019). Even products whose names remain the same can undergo changes in the manufacturing process, due to industrialization. By valuing these foods, they become more appealing and marketable, inhibiting informal marketing and promoting rural development (KAMIMURA et al., 2019; SOBRAL et al., 2017). In this context, the objective of this study was to characterize the colonial cheese produced produced both by farmers and by formalized family agribusinesses in the state of Rio Grande do Sul, especially with regard to the recipe, ingredients and production processes, as well as social and economic aspects of producers and the colonial cheese chain.

MATERIALS AND METHODS

Determination of sample size

To define the sample size, data from the Socioeconomic Report of the Milk Production Chain in Rio Grande do Sul was used (INSTITUTO GAÚCHO DO LEITE, 2015). The target population was defined based on the number of properties that produce colonial cheese: 224 formalized family agro-industrys and 8,093 producers that sell home-made dairy products. From these definitions, the sample size for a finite population (n=8,317 producers) was calculated based on the estimated population proportion (RYAN, 2013), with a 90% confidence level and 5% margin of error. With the definition of the sample size, we chose to use the conglomerate sampling method, dividing the state of Rio Grande do Sul into seven meso-regions: Northwest, Northeast, East Center, West Center, Metropolitan, Southeast and Southwest. The number of rural properties sampled in each meso-region was calculated proportionally to the total number of producers. The choice of properties to be sampled in each meso-region was up to the municipality's Emater-Ascar extensionist, who selected representative producers from each region.

In total, 293 rural properties were sampled, of which 82 have a formalized family agroindustry (FA), registered with the local inspection service, and 211 carry out the manufacture of colonial cheese for family consumption or informal sale, which is called manufacturing homemade (HP).

Questionnaire

In order to assess the rural properties, a questionnaire consisting of 22 questions was created. The questions were grouped into three blocks: the socioeconomic profile, the productive profile of the property, and the characterization of the cheese (BERNUÉS & HERRERO, 2008; GARCÍA et al., 2012; KAMIMURA et al., 2019).

The characterization of the cheese is explained by five indicators, which group the main factors that characterize the cheese product. The groups are: raw material, in this case milk, production process, physical aspects, ingredients, and social aspects.

Regarding the milk group, this research considered aspects related to the milk composition, such as breed and type of animal feeding. Processing-wise, the % of fat, the steps used to obtain the cheese and the maturation time were considered. In relation to the physical aspects, color, shape, and weight were considered, and in relation to the ingredients, the addition of salt, rennet, yeast, and spices was considered. Finally, in relation to the social aspects, the relationship of trust between producer and consumer, the origin of the recipe and tradition in production were researched.

Surveying was carried out by extensionists from EMATER/RS-Ascar, during a visit to each property, while the colonial cheese was collected for

physicochemical analyses. The visits took place from June 2016 to December 2017.

Physicochemical analysis

The physicochemical analyses were carried out by the food analysis laboratories of the Lutheran University of Brazil (ULBRA), in accordance with the established protocols (Normative Instruction no. 62 of MAPA (Brazil, 2003). The 293 samples were delivered packaged in thermal boxes and identified with code, date of manufacture, and maturation time.

Statistical analysis of data

Data were subjected to hierarchical cluster analysis to define groups of homogeneous samples with similar characteristics. First, properties with insufficient information were excluded, leaving 285 properties for Cluster analysis. Next, data were standardized, and then a similarity matrix was generated between all samples, using the Euclidean distance. The next step was choosing of the grouping method, comparing the 'Ward', 'Single', 'Average' and 'Complete' methods by cophenetic correlation. The grouping method adopted was the 'Average', which presented a cophenetic correlation=0.890. For these procedures, the vegan package of the statistical program R (v.4.0.4) was used. Subsequently, the number of clusters was defined using the 'NbClust' package of the R statistical software.

Finally, the data regarding the profile of the producers, productive and economic indicators, and characterization of the cheese were submitted to comparison analysis between the formed clusters, considering a 5% significance level (P < 0.05). Binomial variables (presence or absence) were analyzed using the 'glm' function of the R statistical program, while numerical variables were submitted to non-parametric analysis using the Kruskal-Wallis test (P < 0.05). When significant differences were observed between the clusters, the means were compared using the Bonferroni test (P < 0.05).

RESULTS AND DISCUSSION

Using the research data, cluster analysis was conducted. With this statistical technique, two clusters were obtained. Cluster 1 represents 99.3% of colonial cheese producers, that is, it is the cluster that identifies colonial cheese. Cluster 2 represents 0.7% of producers, with peculiar characteristics that differentiate this type of cheese, mainly, by not adding salt, rectangular shape and lower levels of

fat, acidity and chlorides. Cluster 2 was represented by two producers from the Northwest region of Rio Grande do Sul. It is noteworthy that there was no significant difference between the cheese produced by the agro-industry and homemade cheese (P > 0.05). In the next sections, the results are presented and discussed, divided into three themes: characterization of the cheese, profile of producers, productive and economic indicators.

Characterization of colonial cheese

Regarding the processing characteristics and the final product, as shown in table 1, it can be stated that the colonial cheese has a predominantly round shape (60.8%), followed by the rectangular shape (33.9%), weighing in average 1.22kg, with an average maturation period of 9.4 days. These results are in agreement with those reported by Fava (2012) and Silveira Júnior (2012), with cheeses weighing between 0.500 and 1,500 kg and with a cylindrical, rectangular or square shape. However, the average maturation time is lower than that reported by Fava (2012), which was between 30 and 75 days.

Regarding the ingredients used, colonial cheese is produced with whole milk, salt and rennet, calcium chloride (18.3%), yeasts such as yogurt (10.9%) or starter cultures (13.0%) can be used, and still be added seasonings (9.5%) and colorings (2.8%)The shaping step takes place after separating the mass from the whey and in both categories it is performed manually.

Salting occurs at different times: in the milk (25.4%), in the curd (56.2%) or directly in the cheese after molding (14.4%). Maturation, with an average of 9.4 days, occurs both in maturation chambers, with controlled humidity and temperatures, as well as in household refrigerators or on shelves, at room temperature.

Regarding the percentage of fat, colonial cheese (cluster 1) had a content of 47.8%, while cluster 2 had a lower content (P < 0.05), with an average of 32.2% of fat (dry extract). According to Brazilian legislation, cluster 2 cheese is classified as semi-fat, whereas cluster 1 cheese is classified as fat. Similar results were reported by DE MEDEIROS CARVALHO et al., (2019) for informal colonial cheeses produced in the state of Santa Catarina, with 58.4% of the analyzed samples classified as semi-fat and 8% as extra-fat. In the study by SILVEIRA JÚNIOR et al. (2012), all samples were classified as fatty cheeses, with percentages of fat in the dry extract varying between 42.10 and 59.38%, depending on the season. This variation can be explained by the fact

Table 1 - Characterization of colonial cheese.

Parameter	Cluster 1	Cluster 2	Mean	P-value
--Milk--				
Holstein breed	21.8	11.0	21.7	0.773
Jersey breed	41.6	70.8	41.8	0.244
Cross Dutch x Jersey	20.0	10.0	19.9	0.916
Others breeds	16.6	8.1	16.5	0.924
Pasture Production System	91.9	100.0	91.9	0.990
--Ingredients--				
Salt addition	100.0	0.0	99.3	0.999
Yeast addition	13.0	0.0	13.0	0.989
Whole milk	95.0	100.0	95.1	0.994
Whey addition	3.2	0.0	3.1	0.994
Rennet addition	98.9	100.0	98.9	0.996
Calcium chloride addition	18.3	0.0	18.2	0.989
Skim milk	3.2	0.0	3.1	0.994
Yogurt addition	10.9	0.0	10.8	0.990
Food colors addition	2.8	0.0	2.8	0.994
Seasonings addition	9.5	0.0	9.5	0.990
--Physical aspects--				
Weight	1.22	1.25	1.22	0.762
Round shape	60.8	50.0	60.7	0.757
Rectangular shape	33.9	100.0	34.4	0.981
Square shape	13.0	50.0	13.3	0.184
--Process--				
Fat	47.8 a	32.2 b	47.7	0.022
Acidity	0.61	0.30	0.61	0.156
Chlorides	0.91	0.38	0.91	0.113
Moisture	46.5	47.7	46.5	0.743
Maturation	9.4	7.5	9.4	0.741
Pasteurisation	47.3	50.0	47.3	0.940
Salting in the curd	56.2	50.0	56.1	0.860
Salting in cheese	14.1	0.0	14.0	0.567
Salting in milk	25.4	0.0	25.2	0.410

Means accompanied by distinct letters on the line differ by Bonferroni test (P < 0.05).

that some properties perform partial skimming of milk to use the cream (DE MEDEIROS CARVALHO et al., 2019).

Regarding moisture, colonial cheese has an average moisture content of 46.5%, being classified as a high moisture cheese. A similar result was reported by DE MEDEIROS CARVALHO et al., (2019) in a study carried out with colonial cheese, where all samples were classified as high moisture cheese. The samples analyzed by SILVEIRA JUNIOR et al (2012) were also classified as high moisture, with values ranging between 47.02 and 55.01%.

Regarding the titratable acidity of the cheese and the number of chlorides, it was possible to verify that the average acidity in g of lactic acid/100g was 0.61 while the number of chlorides was 0.90g NaCl/100g. The acidity was within the means reported by SILVEIRA JUNIOR (2012), which ranged between 0.35 and 0.79. The mean of chlorides found (0.90g NaCl/100g) was higher than that found by SILVEIRA JUNIOR (2012), whose means ranged between 0.25 and 0.64gNaCl/100g and higher than that reported by Tavares (2019), whose mean was 0.5g NaCl/100g.

Regarding the bovine herd used, 41.6% of producers use Jersey animals, followed by 21.8% (Dutch), 20.0% (Dutch x Jersey cross), and other breeds (16.6% of producers). The production system is basically pasture (91.9% of producers).

Particularities related to the production process

The producers heat the milk to add the rennet, with an average temperature of 35.3 °C. The mean value of the coagulation temperature is as prescribed by Fox (FOX & COGAN, 2004).

After coagulation, the curds are cut in different ways: using lyra, in the case of family agro-industries, and with the use of skimmers, knives and their own hands, in the case of homemade production. Afterwards, the stirring and heating of the curd begins, which is performed by 67.7% of the producers.

The presence of eyelets in the mass was reported by 69.1% of respondents.

The profile of the colonial cheese producer

Colonial cheese, both homemade production and family agroindustry, is produced by family farmers, if we consider the parameters defined by Law 11.326 of June 24, 1996. (Table 2).

Following the historical characteristics of the product, those responsible for the manufacture of colonial cheese are mostly women (87.9%), mainly of Italian origin (43.1%) and German (18.7%). The historical trace is reinforced by the results regarding the origin of the revenue: familiar to 68.0% of producers. Only 13.8%, 10.6% and 4.9% declared to have learned how to make cheese through courses, with technicians and acquaintances, respectively.

Table 2 - Profile of the colonial cheese producer.

Parameter	Cluster		Mean	P-value
	1	2		
Family origin (%)				
Italian	43.1	0.0	42.8	0.981
Germany	18.7	0.0	18.6	0.989
Producer characteristics				
Average age (years)	49.6	52.0	49.6	0.786
Education: incomplete primary school	52.5	-	52.5	-
Education: complete primary school	19.8	-	19.8	-
Education: secondary school	22.3	-	22.3	-
Education: higher education	5.4	-	5.4	-
Property Features				
Total area (ha)	25.7	16.5	25.7	0.628
Percentage of own area	88.5	100.0	88.6	0.616
Number of residents	3.6	3.0	3.6	0.602
Number of adults working on the property	2.6	4.0	2.6	0.117
Number of young people working on the property	1.5	1.0	1.5	0.477
Properties with permanent employees (%)	8.5	0.0	8.4	0.990
Responsible for making the cheese (%)				
Woman	879.	100.0	88.0	0.989
Men	11.5	0.0	11.4	0.990
Young	1.5	0.0	1.5	0.996
Revenue source (%)				
Familiar	67.8	100.0	68.0	0.3319
Acquaintances	4.9	0.0	4.9	0.747
Courses	13.8	0.0	13.7	0.572
Technical	10.6	0.0	10.5	0.627
Cheese Characteristics				
Manufacturing time (years)	19.8 a	2.5 b	19.7	0.038
Sales time (years)	16.0 a	1.5 b	15.9	0.037

Means accompanied by distinct letters on the line differ by Bonferroni test (P < 0.05).

These results demonstrated that women have been the guardians of the know-how that involves colonial cheese, and its transmission has taken place within the family and community through generations of rural producers.

The average age is 49.6 years, the youngest being 18 years old, and the oldest 79 years old, the sample; therefore, being formed by a wide range of age groups.

As for the level of education, 52.5% have incomplete primary education, and only 5.4% have completed higher education. Low education level seems to be a problem for dairy production. Dairy production seems to be influenced by low levels of education, as this study found a significant correlation (r=0.28, P < 0.001) between producer education and production of milk/day on the property. In other words, the higher the producer's education, the greater the daily milk production on their properties, showing that the level of education is a factor that influences productivity. Conversely, there was also a significant negative correlation (r=-0.24, P < 0.001) between age and litres of milk/day. The older the producer, the lower the daily production in their businesses. A problem that seems more serious if we add the fact of the low number of young people living and working in the properties. Other surveys showed that the children of colonial cheese producers, especially those who make homemade cheese, have not learn the trade and are not interested in continuing in the activity, or in remaining rural (AMBROSINI et al., 2020a).

Rural properties have an average total area of 25.7 ha, with 88.6% of producers having their own area and only 11.4% rent areas from third parties, with an average of 18.3 ha for these areas. On average, 3.6 people live on the property, with 2.6 adults and 1.5 young people working in the establishments. Concerning the workforce, it is predominantly family, as only 8.5% have permanent employees, with an average of 2 employees.

Each producer interviewed has been manufacturing the cheese for approximately 20 years, selling it for 16 years. This reinforces the historical trait linked to colonial cheese, a product that is part of the producers' eating habits, prior to becoming a source of income. The time of manufacture and sale of cheese differed between the clusters (P < 0.05), in which the production and sale of cheese in cluster 2 is more recent, 2.5 and 1.5 years, respectively.

Productive, economic and market access indicators

A considerable portion of cheese producers are inserted in the dairy chain (48.8%). In addition to producing cheese, these producers sell a part of their milk to agribusiness. In terms of volume, this sale represents 11.7% of the milk produced by them.

Milking structures, for most producers, are stables with masonry floors (56.7%), but almost 20% have stables without floors, while 13.3% of producers only have a milking room with a pit or ramp. Access to equipment that reduces the burden of work is even more restricted: only 8.1% of producers have a mechanical milking, 11.6% have piped milking, while 61.6% practice manual milking. For these data, there was no difference between the clusters.

Family units mainly use milk produced on the property. Only 3.7% of processed milk is purchased from third parties, which represents 13.5% of establishments. On average, they have 19 cows on the property, 9 of which are lactating, which produce 146.5 liters of milk a day. There was no statistical difference (P > 0.05) between the clusters for these indicators (Table 3).

Cheese production is continuous throughout the year for most producers (85.8%). Producing cheese and selling milk seems to be part of the families' strategy to improve perceived income since the main motivation for cheese production was "to increase the property's income", 75.2% chose this alternative, with no difference between the clusters. The other reasons were "family tradition" (26.1%), difficulty in meeting the requirements of the industry (6.5%) and lack of industries interested in purchasing milk (5.9%), in addition to other reasons (5 .6%).

Indeed, the sale of cheese represents a contribution of 38.6% to the property's income; even considering other incomes, such as retirement or external salaries, cheese contributes to 32.3% of the total income of families, with no significant difference between the clusters, which shows the importance of the activity. This data demonstrated that the role of colonial cheese changed over time; from a product destined for self-consumption and occasional exchanges, it became a considerable source of income. In addition to volume, producers point out that constant production ensures a certain income every month of the year. Among other things, this will cover current expenses like water and electricity (AMBROSINI et al., 2020a).

Direct consumer sales predominate as the main channel for accessing colonial cheese to the market: 32.3% of the cheese produced is sold this way on properties, 24.5% in the city, and 12.4% at farmer´s markets. The volume of cheese sold to retailers in the city and properties reaches 13.8%, and 4.5% to intermediaries. Cluster 2 had the highest (P < 0.05) percentage of sales to consumers at farmer´s markets, 80.0%.

Table 3 - Productive and economic indicators.

Parameters	Cluster		Mean	P-value
	1	2		
---Productive indicators--				
Dairy cattle farming (%)	96.4	100.0	96.5	0.994
Total number of animals	19.1	14.5	19.1	0.891
Number of lactating cows	9.2	8.0	9.2	0.807
Total milked (liters/day)	146.5	-	146.5	0.685
Milk sold to industry (%)	11.7	-	11.7	0.634
Milk purchased from third parties (%)	3.7	-	3.7	0.765
---Type of milking machine (%)---				
Manual milking	62.0	0.0	61.6	0.981
Channeled	11.7	0.0	11.6	0.989
Mechanical milking	8.1	0.0	8.1	0.990
Non	13.5	100.0	14.0	0.192
---Milking location (%)---				
Stable with masonry floor	56.4	100.0	56.7	0.981
Hard soil stable	19.1	0.0	19.0	0.989
Corral	2.1	0.0	2.1	0.994
Milking room with a pit or ramp	13.5	0.0	13.3	0.989
---Production season (%)---				
Continuous	85.8	100.0	85.9	0.989
Seasonal	10.9	0.0	10.9	0.999
--Sale (%)---				
For consumers on the property	32.4	25.0	32.3	0.734
For consumers at the farmer´s market	12.4 b	80.0 a	12.6	0.042
For retailers at the property	4.0	0.0	4.0	0.748
For consumers in the city	24.5	35.0	24.5	0.295
For intermediaries	4.5	0.0	4.5	0.727
For retailers in town	9.8	0.0	9.8	0.639
---Economic indicators (%)---				
Contribution to property income	38.7	1.0	38.6	0.103
Contribution to total family income	32.4	10.0	32.3	0.435
--Reasons for making cheese (%)--				
Increase income on property	75.3	50.0	75.2	0.432
Family tradition	26.2	0.0	26.1	0.989
Difficulty in meeting industrial requirements	6.6	0.0	6.5	0.999
Lack of industries interested in purchasing milk	6.0	0.0	5.9	0.999
Other reasons	5.6	0.0	5.6	0.994
---Main difficulties faced (%)--				
Legalization	48.0	0.0	47.8	0.987
Lack of credit	6.0	0.0	6.0	0.993
Difficulty to sell	7.3	0.0	7.3	0.993
Low price	15.5	100.0	15.8	0.985
Other problems	15.6	0.0	15.5	0.988

Means accompanied by distinct letters on the line differ by Bonferroni test ($P < 0.05$).

The main difficulties faced in the production of Colonial Cheese, according to the producers, are related to legalization (47.8%), followed by the low sale price (15.8%), difficulty in selling (7.3%) and lack of credit (6.0%), with no difference between the clusters (P > 0.05). Other problems were highlighted by 15.6% of the producers.

The results reported showed the historical and socioeconomic importance of colonial cheese and the need to value this type of production, which are in line with the FAO Sustainable Development Goals (SDGs), especially concerning food security and promotion of sustainable agriculture: Goal 2 is that, by 2030, countries develop programs and policies that can double the productivity of small farmers, including women and indigenous peoples, in order to increase the income of their families.

CONCLUSION

Based on the findings of this study, colonial cheese, which has its origins in Italian immigration, was produced throughout southern Brazil and was passed from generation to generation through tacit knowledge. The production method is artisan and maintains fairly uniform characteristics. It is made with three main ingredients: whole milk, rennet and salt, mainly in a round shape, weighing an average of 1.22 kg, with an average maturation of 9.4 days, with high moisture and fat, using raw or pasteurized milk.

Colonial cheese is manufactured by women, characterized as family farmers, on small properties, with pasture-based animals and family labour, for approximately 20 years. Colonial cheese has gone from being a family-only product to contributing 30% to family income, sold directly to consumers.

This research contributed to the characterization of colonial cheese, generating subsidies for safeguarding its name and protecting the way of making it, preserving the cultural property, improving income, and staying young people in the countryside. Additional studies and public policies are needed to value cheese on the following topics: maturation of raw milk cheese for less than 60 days, offer of training and technical assistance in good manufacturing practices, legislation suitable for artisan production.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors contributed equally for the conception and writing of the manuscript. All authors critically revised the manuscript and approved of the final version.

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