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PHYSICOCHEMICAL CHARACTERISTICS OF KOCHKÄSE CHEESE

Davi Scharf Higino da Silva[1], Isadora de Andrade Paulo[1], Daniela Rausch[1], Thaís Costa Nihues[1], Marcel Jefferson Gonçalves[1], Carolina Krebs de Souza[1], Vanderleia Botton[1] , Jaci Carlo Schramm Câmara Bastos[1] , Marcela Kotsuka da Silva[1*] & Lisiane F. Carvalho[2]

[1]*Chemical Engineering Department, Regional University of Blumenau, Blumenau, Brazil.*
[2] *Linking Landscape, Environment, Agriculture and Food, Institute of Agronomy, University of Lisbon, Lisbon, Portugal*
** Corresponding author's email address: marcelakotsuka@furb.br*

ABSTRACT

Kochkäse is an artisanal production cheese, made from raw milk, that was brought by German immigrants that colonized Vale do Itajaí region, in Santa Catarina (Brazil), during XIX century. In Brazil, there is a wide variety of artisanal cheeses that are still little known and the increase in research about their properties demonstrates the importance of the topic, for scaling up searching for its industrialization. With this in mind, the objective of this study is to analyze physicochemical properties and composition of Kochkäse cheese. For this, different agitation velocity and temperature were analyzed during cooking phase. Results showed that Kochkäse is a pseudoplastic fluid, fitting the Ostwald-de Waele Model with a R^2 of 0.9736. In relation to composition, the cheese has 0.32% of lipids and 69.3% of humidity. Besides, it was showed to be a slight acid cheese with 18.2% of acidity, and no carbohydrates were detected. With these results it was possible to identify the Kochkäse physicochemical characteristics, expecting that this research contributes to increase the cheese commercialization by the maintenance of existing producers and likewise the new producers.

Keywords: Kochkäse. Artisanal cheese. Composition. Physicochemical properties.

1 INTRODUCTION

Cheese is consumed around the world due to its flavor, smell and texture appreciated by consumers. It is a food that arouse interest by its culinary versatility, it is estimated that 40% of cheese is used either as ingredient or component in other foods (Mcsweeney et al., 2017). The cheese is made by different compounds and molecules, like fatty acids, amino acids, alcohols, lactones and others compounds that together represents the properties of food (Tilocca et al., 2020). Cheese, a fermented milk-based food, can be considered a complex ecosystem composted by a diversity of microorganisms that can be found in the milk or in the starter used by cheese manufacturing (Khattab et al., 2019).

Kochäse is a cheese that has been produced and consumed by a population of Germanic Origins that resides in Vale do Itajaí in state of Santa Catarina (Brazil). Also known as s*tinkkäse* (stink cheese) traditionally made by farmers that learned and exchanged the recipes by family's generations (Dallabrida et al., 2018).

Considering cultural and commercial importance of the kochkäse cheese, the focus of this research is to evaluate physicochemical properties, in relation to composition and rheological behavior, for a better understanding of kochkäse behavior during the cooking process and stimulate its commercialization.

2 MATERIAL & METHODS

A pre-salted fermented white cheese provided by a rural producer from Vale do Itajaí region, specialized in kochkäse production, was used for the experimental analyses. The cheese was kept in freezer at 5ºC until de execution of the tests. For each test, 250 g of white cheese were used. Although the provided cheese came from the same producer, samples 1 to 4 came from a batch, while samples 5 to 7 from another one, being the difference of one mouth between them.

The influence of agitation velocity and temperature on kochkäse's viscosity were verified during the cooking phase through a 2^2 factorial design with three replicates at center point. Temperature of 75, 85, 95 ºC, and agitation velocity of 30, 50 and 70 rpm, were evaluated.

To maintain the control of agitation velocity during the tests, a mechanical agitator (IKA RW 20 digital) was used. In order to reach the desired temperatures, the samples were heated with a thermal plate, with the temperature value being verified with a thermometer. Also, for assisting the thermal distribution, the beaker containing the samples were kept inside another beaker with water (simulating a double boiler). Due to solid consistency of the white cheese, the samples were pre heated on the test's temperature so, it was possible to start mixing. Each sample were kept in constant velocity and heating for 2 minutes.

For viscosity determination, the falling ball viscometer method was employed. The sphere used has 16.186g of mass, volume of 1.992 cm^3 and density of 81.269 g/mL. These analyses were conducted immediately after the end of the agitation/temperature tests.

With the viscosity values defined, kochkäse fluid classification was determined according to the dynamic behavior. However, it is worth mentioning that this classification is only valid for temperatures higher than 75ºC, since when the cheese cools down it tends to become less viscous.

3 RESULTS & DISCUSSION

From the obtained results, fluid type, which represents the fluid dynamic characteristics of kochkäse, was evaluated. Table 1 shows the results of viscosity obtained according to factorial design.

Table 1 Shear rate and viscosity of cheese samples.

Sample	Velocity (rpm)	Temperature (ºC)	Shear rate (s^{-1})	Viscosity (Pa.s)
1	30 (-1)	75 (1)	0.093	795.57
2	30 (-1)	95 (-1)	0.171	341.18
3	70 (1)	75 (1)	0.054	1152.90
4	70 (1)	95 (-1)	0.099	585.08
5	50 (0)	85 (0)	0.166	349.50
6	50 (0)	85 (0)	0.161	354.78
7	50 (0)	85 (0)	0.171	327.39

It is noticed in Table 1, sample 3 showed the lower value for shear rate while sample 2 and 7 showed the highest values. In relation to viscosity sample 3 showed a higher value, in meanwhile sample 7 has the lower value, thus when higher the shear rate, lower is viscosity.

Temperature effect is higher than agitation velocity, however with opposite tendencies, when lower the temperature, higher is value for viscosity and when higher the agitation velocity, higher is value for viscosity.

Comparing the velocities range analysed with kochkäse are relatively very smalls with those in literature (Lenze, 2019). Considering that the cooking time of 2 minutes was applied, it can be assumed that the viscosity of the cheese has not reached the maximum value, since the protein matrix is still being create and does not have a stable form, thus a sudden decrease or a stabilization of viscosity were not noticed in this case.

In order to evaluate the fluid dynamic behavior of kochkäse and define if temperature and/or agitation velocity has influence in the cheese's viscosity, rheological models were applied to determine the best model fit. Figure 1(a) represents the behavior using Ostwald-de Waele model and Figure 1(b) demonstrate the behavior for Bingham model.

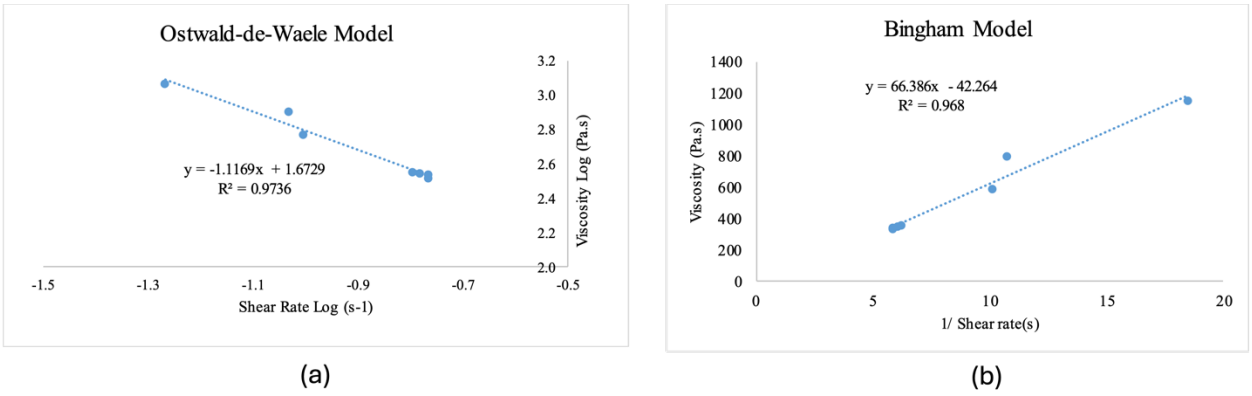

Figure 1 Ostwald-de Waele model.

Figure 2 Bingham model.

It is notice that when Ostwald-de Waele model is employed, viscosity tends to reduce with the increase of shear rate, and according to the regression, the fluid behavior index, n, is -0.1169. In meanwhile, the equation generated by Bingham resulted in an adjust slight inferior (R^2 = 0.968) when comparing to Ostwald-de Waele model, showing that it best represents the kochkäse rheological behavior. Besides, as the index fluid behavior (n) is lower than 1, it means that kochkäse is considered a pseudoplastic fluid.

In relation to kochkäse physicochemical composition analyses, the mean value and standards deviation, and Tukey Test for each sample, are presented in Table 2.

Table 2 Physicochemical composition for sample of kochkäse.

Sample	pH	Acidity(%)	Humidity(%)	Lipids (%)	Ash (%)	Proteins (%)
1	6.07 ± 0.02^{a}	18.27 ± 2.75^{b}	69.92 ± 0.32^{a}	0.61 ± 0.36^{a}	1.72 ± 0.04^{a}	25.13 ± 0.47^{a}
2	5.91 ± 0.05^{a}	21.99 ± 0.97^{a}	68.31 ± 1.09^{a}	0.26 ± 0.11^{a}	1.65 ± 0.01^{a}	23.49 ± 0.37^{ab}
3	5.98 ± 0.01^{a}	13.00 ± 0.74^{d}	70.03 ± 0.28^{a}	0.29 ± 0.02^{a}	1.59 ± 0.13^{a}	22.43 ± 0.32^{b}
4	6.08 ± 0.03^{a}	21.27 ± 1.96^{a}	68.80 ± 0.31^{a}	0.29 ± 0.02^{a}	1.67 ± 0.03^{a}	22.72 ± 0.22^{b}
5	5.95 ± 0.04^{a}	15.85 ± 2.56^{c}	69.46 ± 0.42^{a}	0.16 ± 0.01^{a}	1.57 ± 0.01^{a}	23.82 ± 0.37^{ab}

Note: Result with same letters in the same column did not present significant difference between each other and different letters presented significant difference in $p < 0.05$ for Tukey Test.

According to results obtained, it can be observed that there is no significant difference for pH between the samples. The results showed that there is no direct influence of temperature and agitation velocity in pH. In relation to acidity results, tests showed a significant difference between samples, except for samples 2 and 4, which means that from the temperature of 95ºC and above, the agitation velocity no longer impacts in the acidity of the cheese. For the humidity tests, no significant difference exists between sample, meaning that the results show that the cooking temperature and agitation velocity did not influence the humidity content. According to Brazilian's Technical Regulation of Identity and Quality for kochkäse, the result follows the necessary requirements, where the humidity is higher than 55% (Santa Catarina, 2020).

For the lipids, the Tukey test revealed that no significant difference was found between samples, concluding that temperature and agitation velocity, has no influence in total lipids. The results for lipids, obtained in this research, were lower than 10%, which means, they are in accordance with the Technical Regulation of Idendity and Quality of Kochkäse (Santa Catarina, 2020). Evaluating proteins, it was noticed a significant influence only between sample 1and 3 and samples 1 and 4. This means that velocity has influence in proteins until temperatures of 85ºC, but after that the same phenomenon no longer occurs. It is possible to conclude that in both temperature and velocity range evaluated, there was changes in the protein network of kochkäse cheese, that could even be different structures between samples, mostly in lowers temperatures than 85ºC.

4 CONCLUSION

In relation to viscosity, considering that consumer in general search for a cheese with a creamy texture making easy to spread, sample 4 makes the best choice for kochkäse production, because this sample allies good viscosity, great acidity and all the other physicochemical properties are relatively near the mean value. Kochkäse production is still familiar, thus one of the focus of this research was to evaluate the best conditions to scale up; and according to the obtained results it is very important to control the temperature at 95ºC, maintaining a constant agitation velocity of 70 rpm. According to physicochemical results, kochkäse cheese has mean pH of 6; acidity of 18.2%, humidity of 69.3%; lipids of 0.32%; ash content of 1.64% and protein of 23.52% and absence of carbohydrates, due the fermentation process that kochkäse is subject. The obtained results are in agreement with legislation.

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