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CROSS-FLOW MICROFILTRATION OF TRADITIONAL KOMBUCHA BEVERAGE USING CERAMIC TUBULAR MEMBRANE

Highlights

- The impact of microfiltration on the quality of traditional kombucha was examined.
- A ceramic tubular membrane was used for cross-flow microfiltration.
- Microfiltration effectively enhanced its visual quality.

Abstract

The traditional kombucha beverage is produced through the metabolic activity of the microorganisms present in the kombucha culture on sweetened black tea at room temperature. The aim of this study was to investigate the influence of cross-flow microfiltration on the quality of the produced beverage. The produced beverage was microfiltered to assess the effect of cross-flow microfiltration on its quality. The quality characteristics examined included pH, total acidity, total soluble solids, turbidity, organic acids, in vitro antioxidant potential, and vitamin C as an antioxidant compound. The operational parameters of the process were transmembrane pressure (0.2, 0.6, and 1 bar) and feed flow rate (30, 90, and 150 Lh^{-1}). The maximum permeate flux was achieved at the highest feed flow rates and transmembrane pressures. Microfiltration maintained (pH, total acidity, total soluble solids, lactic, formic, and oxalic acid), improved (turbidity and acetic acid), but also declined (malonic acid, vitamin C, and antioxidant potential), the quality of the traditional beverage. After the microfiltration, turbidity was reduced by 7-9 times, and the content of acetic acid amounted to around 1.20 g/L. The lowering of acetic acid content indicated the inhibition of acid buildup. Values of the coefficient of retention for all of the examined quality parameters, except turbidity, suggested that the overall influence of microfiltration was moderate.

Keywords: SCOBY, membrane filtration, physicochemical properties, biological potential.

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INTRODUCTION

Health drinks are one of the fastest-growing beverage categories amid growing public health concerns. These drinks include ready-to-drink teas, 100% superfruit juices such as pomegranate juice, cherry juice, and cloudy pear juice, mineral waters, herbal teas, kombucha, and other products [1]. Traditional kombucha beverage is produced as a result of the fermentation process conducted on black tea sweetened with sucrose, by the microorganisms present in kombucha. Fermentation usually lasts 7-10 days at a temperature that can be in the range 18-30 °C. Kombucha culture applied in the fermentation is mainly composed of acetic acid bacteria and several yeast species. Sucrose is usually added in the amount of 5 to 10%, and the content of black tea leaves is in the 1.5 to 12 g/L range. In the kombucha beverage production, yeasts metabolize sugars to ethanol, and acetic acid bacteria utilize the obtained ethanol and produce acetic acid. During the fermentation, two phases are formed. One is a nutritionally and pharmacologically active beverage. The other is the floating cellulosic pellicle layer. In order to conduct the production process of kombucha beverages, the liquid part of the kombucha is added to the sweetened black tea extract in the amount of 10-20% (v/v). The pellicle from previously obtained kombucha product is transferred as well [2-6].

Black tea kombucha beverage has a slightly sweet and sour taste, a characteristic odour that resembles vinegar, slight carbonation, and a blurry appearance [2,5]. It can be produced as a non-alcoholic and alcoholic beverage [2]. In our country, there is no legislation on kombucha, and kombucha is regarded as a refreshing soft drink. The alcohol content of these types of food products is defined by the Rules on the quality of refreshing non-alcoholic drinks. According to this regulation, kombucha is considered non-alcoholic when it contains no more than 0.5% (v/v)

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of ethanol [7]. The turbidity of the beverage is attributed to the presence of microorganisms, remains of cellulosic pellicle, and other suspended particles [2,8]. It is very well known that, from the consumer's point of view, blurriness is undesirable, since it can indicate poor quality or contamination. Although kombucha has been produced industrially, additional research at the laboratory scale is ongoing [9].

Techniques used in beverage production have some deficiencies and disadvantages, such as high cost and long retention time. Downstream processing (purification, dealcoholization, etc.) is the most expensive production cost in the beverage industry. The use of membranes can reduce expenses and retention time while also improving beverage quality, so membrane techniques are used at different stages of the beverage manufacturing process [10].

A membrane separation system is a process that uses a permeable membrane to separate different components of a mixture based on properties such as size, charge, and/or solubility. It functions by allowing certain molecules or particles to pass through the membrane but preventing others. A driving force could be pressure, differences in concentration, and/or electrical potential. Membrane processes are energy efficient because they do not require additional heat or chemicals for separation, resulting in less energy and costs for chemicals [10]. The selective, accurate separation results in much higher purity and fewer contaminants in the final products that would be associated with crossover during filtration [11].

In order to make the kombucha beverages clear, microfiltration (MF) can be used [8,11]. MF is a membrane separation technique with pore sizes from 0.1 to 10 μm. It retains microorganisms and particles in suspensions and colloidal solutions. The MF is widely used in the production of various beverages, for clarification, cold sterilization, as well as removing bacteria, with minimal effect on temperature during the process. In this way, the obtained kombucha products are stabilized and clarified, since microorganisms are retained [8,11]. On an industrial scale, it can be applied instead of pasteurization, as well. In this way, the increase in ethanol and acidity of kombucha beverages is prevented [2]. A study demonstrated that MF had almost the same influence as pasteurization on the microbiological quality of raw pomegranate juice [12].

MF membranes can remove particles larger than the pore size and avoid undesirable physical or chemical changes. At the same time, the retention of filtration media components reduces the permeate flow, so the efficiency of the filtration process is affected by membrane fouling. Membranes are typically classified as polymeric and ceramic depending on the material used in their manufacture. Ceramic membranes have been reported to be less susceptible to membrane fouling compared to polymeric membranes because their inorganic substance is more chemically stable, resistant to harsh environments, and has a smoother surface, which minimizes particles' adhesion [13]. With high separation accuracy and excellent resistance to acids, bases, solvents, temperature, and microbial contamination, ceramic membranes are considered an ideal choice for clarification of fermentation broths, hydrolysis, and extraction solutions [14].

The biological potential of black tea kombucha is well established. This beverage is known to possess antioxidant, antimicrobial, anti-inflammatory, antidiabetic, anticancer, and hepatoprotective activity; it improves the immune system and treats gastric ulcers [2,3,5]. However, to the authors' knowledge, there is no literature data on the effect of MF with tubular ceramic membranes on the quality of traditional kombucha beverages. Quality of the kombucha beverages is defined through pH and total acidity, as the main indicators of the fermentation. Turbidity and total soluble solids suggest the sensory receptiveness of the kombucha beverages. Determination of the organic acids profile gives a comprehensive insight into the acidity of these products, and sensory quality as well. Reducing power is a measurement of the electron transfer ability. Antioxidant activity to hydroxyl radical indicates the capacity of kombucha beverages to neutralize these highly reactive radicals that can be generated in the human organism. Reducing power and antioxidant activity to hydroxyl radical are indicators of the antioxidant potential, a type of biological potential of kombucha products. Ascorbic acid is a very well-known antioxidant compound. Biological potential suggests the quality of a food product from a health point of view. The aim of this article was to evaluate the effect of MF on the aforementioned physicochemical properties and biological potential of black tea kombucha after MF using a tubular ceramic membrane.

MATERIAL AND METHODS

Kombucha beverage

Traditional kombucha beverage with black tea was produced using local kombucha culture with the microbiological composition described in Malbaša *et al.* [6]. Fermentation medium was produced by adding 70 g of sucrose and 1.5 g of black tea leaves to 1 L of boiling tap water. Boiling of the prepared mixture was performed for 5 min, and after 20 min, black tea leaves were removed by filtration. When the prepared sweetened black tea decoction was cooled to room temperature (25 °C), 100 mL of kombucha starter liquid (kombucha beverage obtained in the previous fermentation) was added. Fermentation lasted for 7 days at 25 °C. After the production, the beverage was subjected to MF. The cellulosic pellicle layer was removed before the MF. All analyses were performed on the beverage before the MF and samples after MF.

MF experiments

Experiments were performed with black tea kombucha, and membrane cleaning was an acid-base sequence. Membrane cleaning efficiency was evaluated by testing the water flow recovery. All experiments were performed at room temperature (25 °C), repeated three times, and the results were averaged. Experiments were performed in a cross-flow MF unit shown in Figure 1. Details can be found in the literature [15]. A single-channel ceramic tubular membrane with a nominal pore size of 200 nm (Pall Membrane Co., USA) with a length of 250 mm and an inner/outer diameter of 7/10 mm was used. The effective surface area of the membrane was 4.62×10^{-3} m^2. In each

run, 500 mL of black tea kombucha was added to the feed tank. Changing the operational parameters according to the experimental design, permeate flux was calculated from the time required to collect 10 mL of permeate. Permeate was returned to the feed tank to achieve a continuous mode of operation. At the steady state, samples of permeate were collected for the determination of analytical parameters.

Response surface methodology (RSM) was used to evaluate the impact of feed flow and transmembrane pressure. The second-degree polynomial model used to fit the responses was assessed for adequacy using the coefficient of determination (R^2) and model *p*-value. A second-degree polynomial model is represented by Eq. (1):

$$Y = b_0 + \sum b_i X_i + \sum b_{ii} X_{ii}^2 + \sum b_{ij} X_i X_j \quad (1)$$

where *Xi* represents design variables, *b0* is the intercept (constant), *bi* is the linear, *bii* is the quadratic, and *bij* is the interaction effect of the factors; *Y* represents the response

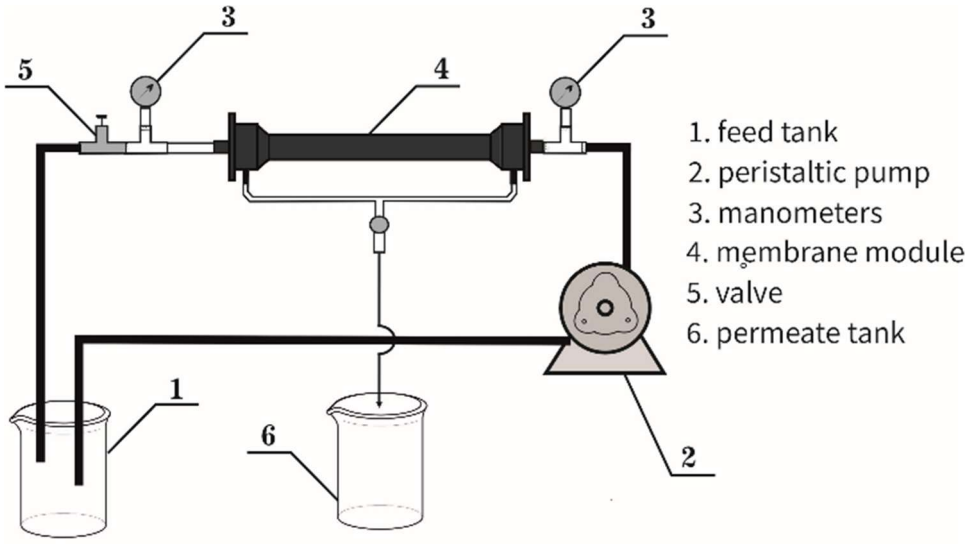

Fig. 1. Schematic diagram of MF apparatus, feed flow from tank (1) to membrane module (4), from (4) to (6) permeate flow, and from (4) to (1) retentate flow.

Physicochemical properties and biological potential

Influence of cross-flow MF on retention rate of the determined solute by the membrane during filtration was measured by the coefficient of retention (%), using Eq. (2):

$$R = 100 \times \left(1 - \frac{C_P}{C_F}\right) \quad (2)$$

where *CP* and *CF* are the values of the solute in permeate and feed, respectively.

pH

pH values were measured using a pH-meter (ADWA AD 1000 pH/mV & Temperature Meter).

Total acidity

The total acidity was determined by a volumetric method [13]. The sample was titrated with a 0.1 mol/L standard solution of sodium hydroxide using phenolphthalein as an indicator. Results were expressed as grams of acetic acid per liter of the sample.

Total soluble solids

The total soluble solids (TSS) content was determined using a hand-held refractometer (ATC, Jiangsu Victor Instrument Meter Co., Ltd.), and the results were expressed as %Brix [17].

Turbidity

The absorbance value of the sample was measured using a spectrophotometer (LLG-uni SPEC 2 Spectrophotometer, LLG LABWARE) at 660 nm, and the turbidity was calculated by the Eqs. (3) and (4) [18]:

$$Transmittance = 100 \times 10 - absorbance \quad (3)$$

$$Turbidity = 100 - transmittance \quad (4)$$

Organic acids (acetic, lactic, malonic, formic, oxalic)

Reversed-phase chromatography on Agilent 1100 Series HPLC, USA, was applied for the determination of organic acids content [19]. The HPLC system consisted of a degasser, binary pump, and ZORBAX® SB-C18 column (4.6 × 150 mm, 5-µm) as the stationary phase, and a UV-DAD detector. Samples were filtered through a 0.45 µm regenerated cellulose membrane filter and, afterwards, 20 µL were directly injected into the HPLC system. Liquid chromatography in isocratic mode was performed with 6 mmol/L phosphoric acid (pH 2.1) as mobile phase and following chromatograph parameters: flow rate 1.0 mL/min, detection wavelength 220 nm, and column temperature 28 °C. External standard method calibration was done. Results were expressed in grams of organic acid per liter of the sample.

Vitamin C

Vitamin C content was analyzed by the reversed-phase HPLC method [20]. The HPLC system consisted of a degasser, binary pump, and ZORBAX® SB-C18 column (4.6 × 150 mm, 5-µm) as the stationary phase, and a UV-DAD detector. Samples were filtered through a 0.45 µm cellulosic membrane filter and, afterwards, 20 µL was injected directly into the system. The mobile phase was 0.1 mol/L ammonium-acetate (pH 5.1) in isocratic mode, with the flow rate of 0.4 mL/min, column temperature set at 40 °C, and detection wavelength of 254 nm. An external method of calibration using a vitamin C standard was performed. Vitamin C content was given in milligrams per liter of the sample.

Reducing power

Reducing power (RP) was determined by the spectrophotometric method [21] with certain modifications. To the 300 µL of the sample, 2.5 mL of 0.2 mol/L phosphate buffer (pH 6.60), and 2.5 mL of 1% potassium ferricyanide were added. The obtained solution was incubated at 50 °C for 30 min. Following, 2.5 mL of 10% trichloroacetic acid was added to the sample tubes. The 2.5 mL of the obtained solution was mixed with 2.5 mL of distilled water and 500 µL of 0.1% $FeCl_3 \times 6H_2O$. Absorbance was measured at 700 nm. The higher absorbance indicated higher reducing power.

Antioxidant activity against hydroxyl radical

Antioxidant activity to hydroxyl radical was determined by the spectrophotometric method [22] with slight modifications. To the 100 µL of the sample the 450 µL of 0.2 mol/L of sodium phosphate buffer (pH 7.00), 150 µL of 10 mmol/L of 2-deoxyribose, 150 µL of 10 mmol/L of EDTA disodium salt dihydrate, 150 µL of 10 mmol/L of $FeSO_4 \times 7H_2O$, 150 µL of 10 mmol/L of H_2O_2, and 525 µL of distilled water were added. The test tube was incubated at 37 °C for 2 h. After that, 750 µL of 2.8% trichloroacetic acid and 750 µL of 0.1% thiobarbituric acid were added, and the sample tubes were incubated at 100 °C for 10 min. Blank sample used 100 µL of distilled water instead of the sample. Absorbance was measured at 520 nm. Antioxidant activity to hydroxyl radical (AA.OH (%)) was given in percentages of inhibition and calculated using Eq. (5):

$$AA.OH(\%) = ((Ablank\ sample - Asample) \div Ablank\ sample) \times 100 \quad (5)$$

where *Ablank* sample is the absorbance of the blank sample and *Asample* is the absorbance of the sample.
All analyses were done in triplicate.

RESULTS AND DISCUSSION

Permeation flux

The permeation flux rapidly decreased with time and reached a steady state after about 1 h. The design variables and their ranges were *X1*: transmembrane pressure, TMP, (0.2, 0.6, and 1 bar) and *X2*: feed flow rate (30, 90, and 150 Lh^{-1}). The experimental plan consisted of nine variable combinations with one replication at the center point, as summarized in Table 1.

Table 1. Experimental design and steady-state permeate flux

Exp. number	Factors		Flux
	TMP (bar)	Q (Lh^{-1})	J ($Lm^{-2}h^{-1}$)
1	0.20	150.00	52.65
2	0.60	150.00	72.38
3	1.00	150.00	88.13
4	0.20	30.00	25.17
5	0.60	30.00	21.41
6	1.00	30.00	17.44
7	0.20	90.00	30.57
8	0.60	90.00	29.41
9	1.00	90.00	40.06
10	0.60	90.00	30.00

Note: TMP, transmembrane pressure; Q, feed flow rate

The summary ANOVA results for steady state permeate flux are shown in Table 2. Quadratic polynomial equation provided more than excellent results, according to high values of the determination coefficients, suggesting that less than 1% of the variations could not be explained by the model. Lack of fit (*p*-value = 0.0923) is not significant.

Table 2. Analysis of variance (ANOVA) for steady-state permeate flux

Source	*df*	SS	MS	*F*-value	*p*-value
Model	5	4862.22	972.44	117.53	0.0002
Residual	4	33.09	8.27		
Lack-of-fit	3	32.92	10.97	63.05	0.092
Pure error	1	0.17	0.17		
Total	9	4895.32			
	R^2		*Adj.* R^2		Adeq. Prec.
	0.993		0.985		32.0

Adequate accuracy is an indication of a signal-to-noise ratio, and its desirable value is at least 4. In this case, the flocculation efficiency ratio of 10.5085 shows that this model may be used to explore the design space and provides a suitable signal. Parity plot, Figure 2, shows reasonable agreement between the observed and the predicted permeate flux values.

Table 3 provides the coefficients of regression equations for steady state permeate flux in terms of the coded and actual variable values, together with their associated *p*-values. The significance of each coefficient was determined by *p*-values. The significance was determined at a probability level of 0.05. Linear and quadratic coefficients of feed flow rate are both statistically significant, whereas in the case of transmembrane pressure, only the linear effect is. The interaction effect is also significant.

The effects of feed flow rate and transmembrane pressure on permeate flux are given in Figure 3.

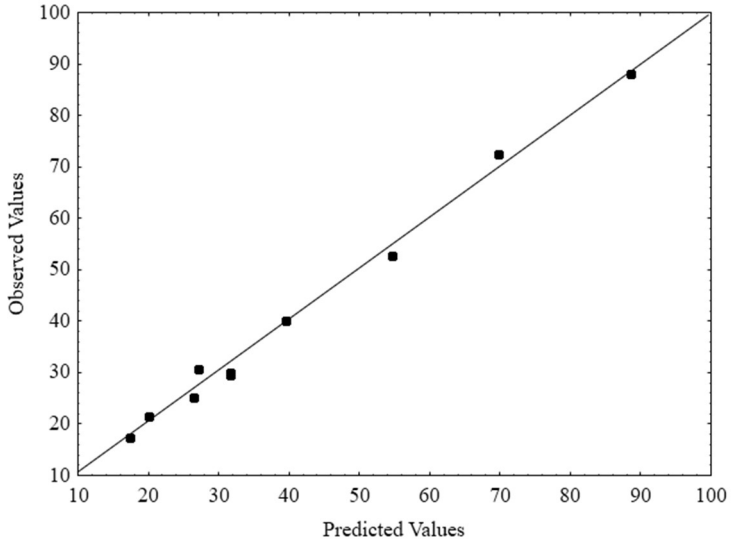

Fig. 2. Parity plot of the predicted and the observed steady state permeate flux.

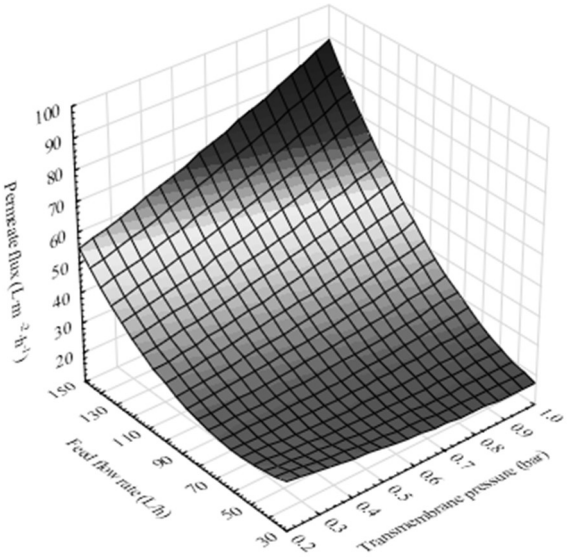

Fig. 3. The influence of transmembrane pressure and feed flow rate on the steady-state flux during kombucha MF.

Table 3. Coefficients of regression equations for steady permeate flux

Effects	Coefficient		*p*-value
	Actual	Coded	
Intercept			
b_0	43.50	31.61	*0.0017*
Linear			
b_1	-38.54	6.21	*0.0061*
b_2	-0.53	24.86	*< 0.0001*
Quadratic			
b_{11}	11.29	1.81	0.3919
b_{22}	3.72×10^{-3}	13.39	*0.0021*
Interaction			
b_{12}	0.45	10.80	*0.0017*

As can be seen, the change in steady-state flow rate becomes more pronounced with changing feed flow rate. An increase in flow rate is observed at all transmembrane pressures. An increase in feed flow rate generates shear forces on the membrane surface, removing components deposited on the membrane surface, which reduces the formation of the polarization layer, and the generated turbulence increases the mass transfer, resulting in a higher permeate flow [23]. Higher tangential velocities tend to prevent fouling and facilitate the subsequent cleaning process of the membrane. Up to 70 Lh^{-1} increase of TMP resulted in slightly higher steady state permeate flux values. For a fixed feed flow rate in the region above 70 Lh^{-1}, the permeate flux significantly increased with the rise of TMP. Cheryan [24] explained that permeate flow is pressure dependent but at some point, becomes independent due to concentration polarization and gel formation, which are more prominent at lower feed flow rates.

pH and total acidity of black tea kombucha before and after MF

In our country, there is no legislation regarding kombucha, so all of the obtained results were discussed in regard to the published scientific literature.

Before the filtration, pH and total acidity values amounted to 3.65 and 2.32 g/L, respectively. MF did not

influence pH and total acidity values. After the filtration, pH values were in the range from 3.56 to 3.62, and total acidity amounted from 2.21 to 2.25 g/L. Coefficient of retention for pH values was around 4% and for total acidity was on stable 3%. Lower values of total acidity after MF indicated that the acidification of the beverage can be prevented by this technique [2]. The values determined for pH were in accordance with results for black tea kombucha published by Malbaša *et al.* [6]. On the other hand, total acidity was approximately two times lower in comparison to values determined by Malbaša *et al.* [6]. This difference can be attributed to the fact that kombucha fermentation was performed at different temperatures. Malbaša *et al.* [6] applied a temperature that was 3 °C higher, and it stimulated the activity of acetic acid bacteria. Daneluz *et al.* [11] also established that the MF had no influence on the pH values of kombucha feed and kombucha permeate. The kinetic diameter of the acetic acid molecule is 0.44 nm, so it passes through the applied membrane. Volatile acidity of kombucha beverages was also not influenced by the MF [11].

Total soluble solids and turbidity of black tea kombucha before and after MF

Total soluble solids are a measure of carbohydrates, proteins, fats, minerals, and organic acids. The value of TSS was not influenced by MF in a statistically significant manner. It amounted to 7.1 before and 6.9 % Brix after the process. Coefficient of retention for total soluble solids was between 1 and 2%. MF reduced the TSS, regardless of the applied parameters. Daneluz *et al.* [11] established that the MF did not influence the dissolved solids (cations, anions, minerals, metals, salts) content of the filtrated kombucha beverage.

The most pronounced and statistically significant influence MF showed on the turbidity values. They were reduced by 7–9 times, and after the MF, turbidity was in the range 4.28–5.59 cm^{-1}. The coefficient of retention for turbidity was around 86% to 89%. According to the dimensions of constituents of kombucha, the membrane applied in this study retained, for example, yeasts and acetic acid bacteria, since they are about 10 times larger than the pore size. This retention resulted in visibly clearer kombucha beverages. These results are in accordance with the ones published by Daneluz *et al.* [11], who also observed a significant reduction in turbidity of kombucha products after MF. These results are presented in Figure 4a.

Organic acids and vitamin C content of black tea kombucha before and after MF

The examined organic acids (acetic, lactic, malonic, formic, oxalic) and vitamin C were detected and quantified in all samples. The content of lactic, formic, and oxalic acid was not influenced by the MF. The content range for lactic acid was 0.13–0.14 g/L, for formic acid, it was 0.07–0.09 g/L, and for oxalic acid, from 0.11–0.12 g/L. The acetic acid content was decreased after the MF and was in the range 1.19–1.22 g/L. Before the process, it amounted to 1.25 g/L. The highest malonic acid value was determined before the MF (0.21 g/L), and after the process, the determined values were in the range 0.15–0.17 g/L. The content pattern of vitamin C was the one established for acetic and malonic acid. Before the MF, it amounted to 2.55 mg/L, and after the process, it was decreased in the range of 2.17–2.33 mg/L.

The coefficient of retention was the highest for malonic acid, and it was around 20% to 30%. From the product quality point of view, higher values of feed flow rate, under all transmembrane pressure values, showed to be more suitable. For vitamin C, the coefficient of retention was around 10%. For all other organic acids, it was lower than 10% and the value was stable for oxalic acid.

This manuscript gives the first insight into the influence of MF on vitamin C and organic acids content, as well as the antioxidant potential of traditional kombucha beverages. All of the examined molecules pass through the membrane, which is in accordance with the size of their molecules. The largest one is the ascorbic acid molecule (59.8 nm), the size of malonic acid is around 0.8 nm, the kinetic diameter of formic acid is 0.4 nm, while the dimensions of others are below 0.2 nm.

Colantuono *et al.* [12] determined that the MF process mainly caused the lowering of quinic, malic, tartaric, and citric acid content in raw pomegranate juice. During the MF of mulberry wine, a small decrease in malic and succinic acid content was established, whilst contents of acetic, lactic, tartaric, and citric acid were not influenced by the filtration process [25].

Vitamin C content was not influenced by MF of acerola juice, when a membrane with 0.3 μm was applied [26]. The results of this study, regarding vitamin C content, follow the same trend as Matta *et al.* [26]. Vieira *et al.* [27] established that vitamin C content was not influenced by the MF with a 200 nm pore size membrane, when performed at 20, 30, and 40 °C. The temperature of 50 °C caused a decrease in ascorbic acid content [27]. These results are presented in Figure 4b.

Reducing power and antioxidant activity to the hydroxyl radical of black tea kombucha before and after MF

Reducing power before the MF was higher in comparison to samples after the filtration. The highest reducing power value was in sample 0 (0.510). Coefficient of retention for reducing power was between approximately 0 to around 30%, depending on the applied process parameters. Lower values of feed flow rate and the lowest and highest transmembrane pressure were found to be more suitable for better product quality characteristics.

Antioxidant activity against hydroxyl radical was the highest for sample 0 (40.31%). All other samples had lower activity in comparison to the value measured before the MF. The coefficient of retention for antioxidant activity to hydroxyl radical was lower than that determined for the reducing power. It was in the range from approximately 0 to around 20%, depending on the process parameters. On average, higher feed flow rate values under all transmembrane pressure values were more favorable for the product characteristics.

The antioxidant potential of the majority of the examined samples was decreased after the MF, which was

in accordance with the results published by Lachowicz *et al.* [28]. This trend was most pronounced for the 200 nm membrane [28]. Obtained results presented in Figure 4c indicated that compounds responsible for antioxidant potential were retained by the applied membrane. The reduction in antioxidant potential was more pronounced for reducing power than for the antioxidant activity to hydroxyl radical, on the basis of the coefficient of retention values. Since both parameters were decreased, this fact should be taken as a compromise when applying MF in kombucha beverage production.

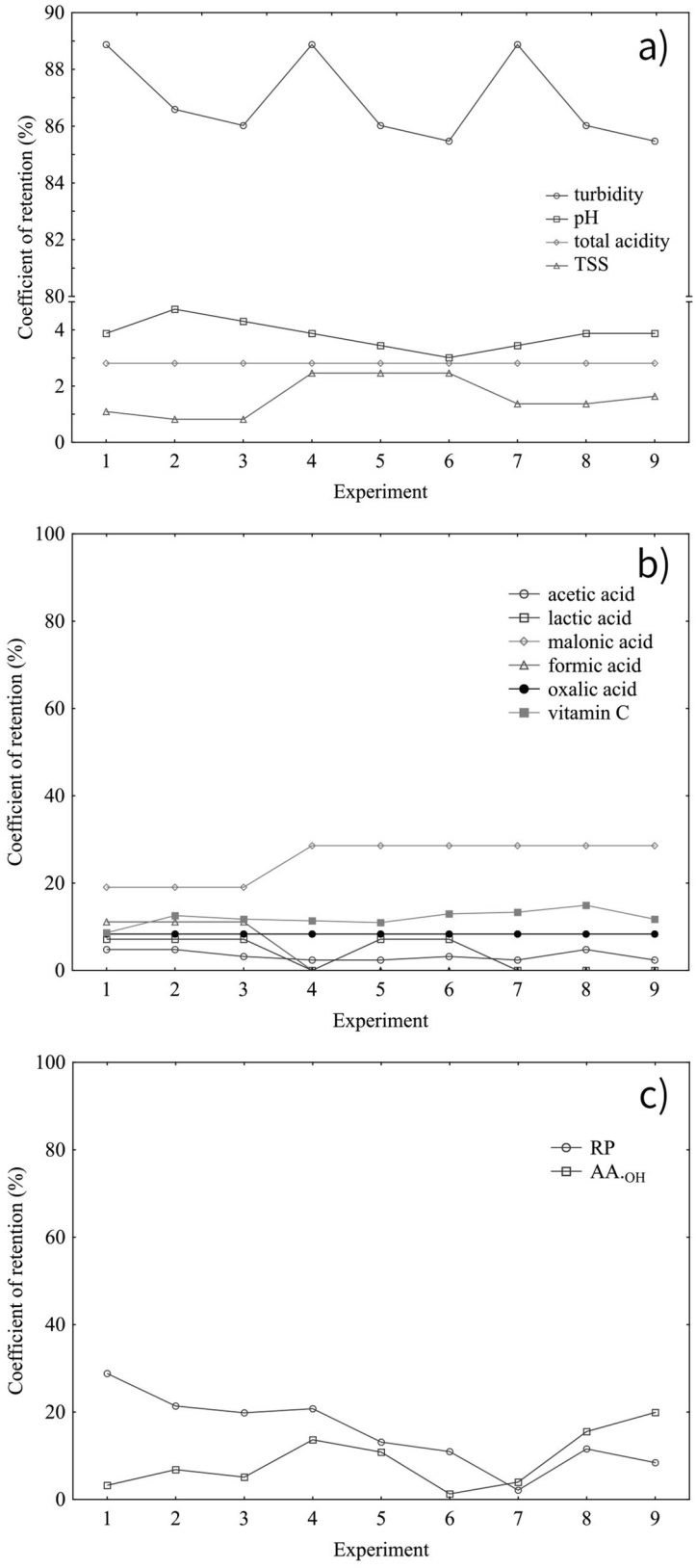

Fig. 4. Coefficient of retention for a) pH, total acidity, turbidity, and TSS; b) organic acids and vitamin C, and c) antioxidant potential

CONCLUSION

The examined type of MF can be successfully applied in the traditional kombucha beverage production. Maximum permeate flux, around 90 $Lm^{-2}h^{-1}$, was obtained for the highest feed flow rate and transmembrane pressure of 1 bar. MF showed the main influence on the turbidity of the kombucha beverage, which was lowered, and therefore, the quality in the means of sensory acceptance of the beverage was improved. Low values of the coefficient of retention suggested that MF had a mild influence on the quality characteristics (pH, total acidity, total soluble solids, organic acids, vitamin C, and biological potential) of the examined kombucha beverage. Further investigation related to MF of kombucha beverages should provide in-depth research on the remaining microorganisms and preservation.

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UNAKRSNA MIKROFILTRACIJA TRADICIONALNOG KOMBUHA NAPITKA PRIMENOM KERAMIČKE CEVNE MEMBRANE

Tradicionalni kombuha napitak se proizvodi metaboličkom aktivnošću mikroorganizama prisutnih u kulturi kombuhe na zaslađenom crnom čaju i sobnoj temperaturi. Cilj ovog rada je bilo ispitivanje uticaja unakrsne mikrofiltracije na kvalitet proizvedenog napitka. Za ispitivanje kvaliteta kombuha napitka merene su i određivane vrednost pH, ukupna kiselost, ukupne rastvorljive materije, mutnoća, organske kiseline, in vitro antioksidativni potencijal, i vitamin C, kao antioksidativno jedinjenje. Radni parametri procesa su bili transmembranski pritisak (0,2, 0,6 i 1 bar) i protok kombuha napitka (30, 90 i 150 Lh-1). Maksimalni fluks permeata je bio postignut pri najvećim vrednostima protoka kombuha napitka i transmembranskog pritiska. Mikrofiltracija je održala pH, ukupnu kiselost, ukupne rastvorljive materije, mlečnu, mravlju i oksalnu kiselinu, poboljšala mutnoću i sadržaj sirćetne kiseline, te umanjila malonsku kiselinu, vitamin C i antioksidativni potencijal. Nakon mikrofiltracije, mutnoća je bila smanjena 7 do 9 puta, a sadržaj sirćetne kiseline je iznosio oko 1,20 g/L, što je ukazalo na inhibiciju u nagomilavanju kiseline. Vrednosti koeficijenta retencije za sve ispitane parametre kvaliteta, sem mutnoće, su ukazale da je sveukupni uticaj mikrofiltracije bio umeren.

Ključne reči: SCOBY, membranska filtracija, fizičko-hemijske osobine, biološki potencijal.

NAUČNI RAD