QUALITY PARAMETERS OF HORIZONTALLY SPRAY-DRIED FERMENTED CABBAGE JUICE

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In the production of fermented cabbage, cell juice of cabbage is released, which is highly saturated in biologically active compounds, but is considered as a by-product. The aim of this study was to evaluate the quality parameters of dehydrated fermented cabbage juice using maltodextrin as a coating agent at various concentrations. In this experiment, fermented cabbage juice was used — spray dried on a horizontal spray-dryer and maltodextrin, in different concentrations (0; 5; 10%). Physical (water activity, solubility, salt content, and moisture), chemical (total phenolic concentration, antiradical activity, and organic and titratable acid concentration) and microbiological (total plate count and lactic acid bacteria) analyses were carried out. The major acids identified were oxalic, quinic, lactic, and acetic acid. Total phenol concentration was influenced by the concentration of maltodextrin used with higher values in the samples with no coating agent. The total viability of microorganisms and lactic acid bacteria ($8.9 \cdot 10^3 - 4.2 \cdot 10^4$ colony forming units (CFU)·g⁻¹) did not reach the probiotic potential according to FAO and WHO. Salt concentration ranged from 8.9% to 14.3%, moisture content was 5.3 % to 7.03%, solubility in water — 81.74% to 82.8%. Horizontal spray drying with maltodextrin as a coating agent proved to be a suitable solution to obtain an innovative product — dehydrated fermented cabbage juice.

Keywords: sauerkraut juice, dehydrated juice, maltodextrin concentrations.

INTRODUCTION

White cabbage (*Brassica oleraceae* var. *capitata* f. *alba*) is a well-known vegetable that is grown worldwide (Šamec *et al.*, 2017) for culinary and medical purposes (Šamec and Salopek-Sondi, 2019). It can be stored raw or fermented as sauerkraut (Šamec *et al.*, 2017). White cabbage leaves are shredded and due to osmotic pressure created by NaCl addition, the cell juice of cabbage is released and fermentation is induced by lactic acid bacteria, present in the raw material. It is highly saturated with biologically active compounds (Raak *et al.*, 2014). In manufacture of fermented cabbage, the cell juice or fermented cabbage juice is considered as a by-product or residue, and can amount to 30% of initial cabbage weight. However, this residue can be used as a valuable source of various bioactive compounds (Beganović *et al.*, 2014). Innovative and sustainable solutions are being explored for utilisation of this worthy by-product. Dried vegetable and fruit powders are convenient for consumption, easy to handle and have a longer shelf life (Pang *et al.*, 2014). They have wide application in the food industry,

supplementing the end product with bionutrients, colour, taste, fibre etc. Various drying techniques are used to make vegetables and their by-products into powder form to stop microbiological activity and preserve the product and its bioactive compounds. The applied drying system has a key role in determining final moisture content, hygroscopicity, quality and shelf life of the obtained product (Salehi and Aghajanzadeh, 2020). Spray drying is recognised for its low cost, high reproducibility and applicability to thermo-labile materials, due to the short drying time (Barbosa and Teixeira, 2017). The liquid substance is sprayed by an atomising device to create small droplets that are “shocked” with hot air, resulting in moisture evaporation and formation of dry solid particles that are separated from the hot air flow in a cyclone (Gharsallaoui *et al.*, 2007). Spray drying is often used in the food industry to ensure the microbiological stability of the product, reducing biological degradation, transport cost and storage (Avila *et al.*, 2015). Drying itself may not be a difficult task, but the choice of a coating agent may be challenging. The function of the coating agent is primarily to reduce stickiness by raising the glass transi-

tion temperature of the substance, but the selection and concentration of the coating agent also influence the powder properties (Barbosa and Teixeira, 2017), and is crucial for the viability of microorganisms during spray drying and storage (Teijeiro *et al.*, 2018). Coating agents with high molecular weight are commonly used for this purpose to equalise substance with low molecular weight that cannot be dried alone in their pure state. Previous studies, performed with malt drink, proved to be effective using maltodextrin as coating agent and spray-drying horizontally (Lidums *et al.*, 2016). Maltodextrin is one of the most common used coating agents, because it increases T_g of the sugar and acid rich products that are heat sensitive, and since it has good solubility and low hygroscopicity (Suhag *et al.*, 2018). It is easy to use in the industry and has no taste or aroma (Avila *et al.*, 2015). Findings from encapsulating *Orthosiphon stamineus* extract and honey powder (Suhag *et al.*, 2018) show better preserved polyphenol compounds and (Pang *et al.*, 2014) probiotic viability using maltodextrin (Medeiros *et al.*, 2014). For every individual product, there is a need to determine the optimum coating agent or combination of several, as well as their concentration, in order to eliminate degradation of bioactive compounds and enhance physical properties (Shishir and Chen, 2017).

The aim of this study was to evaluate the quality parameters of dehydrated fermented cabbage juice using maltodextrin as a coating agent at various concentrations.

MATERIALS AND METHODS

The experimental study was carried out at the Latvia University of Life Sciences and Technologies, Faculty of Food Technology, but spray drying was carried out in Tecoma Drying Technology SRL, Italy.

Spray-drying. Fermented cabbage juice from a cabbage production plant “Dimdipi” was collected after producing sauerkraut by a classic technology used in the fermentation, and delivered to Tecoma Drying Technology SRL, in a 200 l barrel. It was spray dried in a horizontal spray dryer Gatedryer Turbo 150 GGI FB PT with an expected hourly input of $\pm 15 \text{ kg} \cdot \text{h}^{-1}$ inlet/outlet temperature $160/75 \text{ }^\circ\text{C}$, and expected evaporation capacity $135 \text{ kg} \cdot \text{h}^{-1}$. Different maltodextrin concentrations (0, 5, and 10 %) were used. The samples were labelled as follows: 1MD10 – 10%, 2MD10 – 10%, 3MD5 – 5%; and 4MD0 – 0% maltodextrin. $5 \text{ g} \cdot \text{l}^{-1} \text{ CaCO}_3$ was added to neutralise pH (except 2MD10 – $3 \text{ g} \cdot \text{l}^{-1}$).

After spray-drying, the samples were kept in sealed plastic containers, in the dark at $22 \pm 1 \text{ }^\circ\text{C}$ temperature.

Physical, chemical and microbial analysis. Water activity (a_w) was determined using an Aw meter Labswift. Three replications were made for all samples.

Solubility of dehydrated fermented cabbage juice was determined as described previously by Kuck and Noreña (2016): 1 g of dehydrated fermented cabbage juice was mixed with

30 ml of deionised water and stirred for 30 min. The solution was transferred to a centrifuge tube and centrifuged at 3500 rpm for 6 minutes. Then 20 ml of centrifuged solution was transferred into a pre-weighed sand dish and dried at $105 \text{ }^\circ\text{C}$ to constant weight. The solubility was calculated as follows:

$$\text{Solubility}(\%) = \frac{\text{initial weight} - \text{final weight}}{\text{initial weight}} \times 100$$

Moisture content was determined by calculating the weight loss after heating samples at $105 \text{ }^\circ\text{C}$ to a constant weight, according to standard ISO 1666:1996 and expressed on a dry basis.

Salt concentration was determined by titration using Mohr’s method (ISO9297:1989) for determination of chloride, and expressed as sodium chloride. Silver nitrate solution and potassium chromate indicator were used (Korkmaz, 2001).

For determination of titratable acid concentration, 1 g of dehydrated fermented cabbage juice was measured in a 25 ml conic flask. 100 ml deionised water at $90 \text{ }^\circ\text{C}$ was added and the solution was stirred. Three drops of phenolphthalein were added and the solution was titrated with 0.1 n NaOH, till a pink colour occurred. The results were expressed as $\text{g} \cdot 100 \text{ g}^{-1}$.

The organic acid profile was determined (Tomsone *et al.*, 2020), using a high performance liquid chromatograph Shimadzu LC-20 Prominence, equipped with a pump system and UV/Vis detector (DAD SPD-M20A), gradients: A-Acetonitrile; B – 0.05M KH_2PO_4 monitored at 210 nm, column Alltech C18 (4.6 mm $\times$ 250 mm), flow rate $1.25 \text{ ml} \cdot \text{min}^{-1}$, and temperature $35 \text{ }^\circ\text{C}$.

Extracts for determination of total phenol concentration and antiradical activity (DPPH; ABTS⁺) were obtained by two methods based on water and acidified ethanol extractions (Gouw *et al.*, 2017), with modifications.

For the preparation of water extracts, samples of fermented cabbage juice (10 g) and dehydrated fermented cabbage juice (1 g) were extracted with 20 ml deionised water by stirring on a magnetic stirrer for 2 h, then stored at $4 \pm 2 \text{ }^\circ\text{C}$ till further analyses.

For the preparation of acidified ethanol extracts, dehydrated fermented cabbage juice (2 g) was extracted with 30 ml of 60% ethanol acidified with 1% acetic acid glacial in an ultrasonic water bath for 20 min, and then centrifuged for three minutes at 3500 rounds per minute

Total phenol concentration (TPC) was determined using Folin-Ciocalteu reagent, according to Singleton *et al.* (1999), with some modifications. 0.5 ml sample extract was mixed with 2.5 ml Folin-Ciocalteu reagent (diluted ten times with deionised water) and left to react for five minutes. Then 2 ml 7.5% Na_2CO_3 was added and left to react for another 30 minutes. The absorption was read spectrophotometrically at 765 nm wavelength on a JENWAY 6300 (Baroworld Scientific Ltd., UK).

Table 1. Physical and chemical characteristics of dehydrated fermented cabbage juice

Sample	NaCl, g·100 g ⁻¹	Moisture, %	Water activity, a _w	Solubility in water %	Titratable acid, g·100 g ⁻¹
1MD10	8.70 ± 0.34c	5.08 ± 0.28b	0.210 ± 0.005a	81.74 ± 0.66a	0.35 ± 0.11c
2MD10	8.93 ± 0.07c	5.30 ± 0.23b	0.191 ± 0.004b	82.76 ± 0.82a	0.36 ± 0.07c
3MD5	12.23 ± 0.18b	7.04 ± 0.02a	0.198 ± 0.004b	82.80 ± 0.21a	0.38 ± 0.09b
4MD0	14.31 ± 0.07a	7.03 ± 0.14a	0.183 ± 0.004b	82.57 ± 0.54a	0.44 ± 0.09a

Values with different letters are significantly different ($p < 0.05$).

To obtain a stock solution for ABTS⁺ decolouration, potassium sulphate as the oxidant agent was added and left to react for 12 h in the dark. To prepare a working solution, phosphate buffered saline (PBS) was added to the stock solution to reach an absorption of 0.800 ± 0.030 at 734 nm. 0.05 ml sample extracts were added to 5 ml working solution and left to react for 10 minutes. Three replications were made for determination of ABTS⁺ antioxidant activity using spectrophotometry, as described by Rokaya (2013) with some modifications.

To obtain freshly made stock solution for DPPH, 0.004 g of agent were mixed with 96% ethanol to reach an absorption of 1.000 ± 0.02 at 517 nm. 0.5 ml sample extract was added to 3.5 ml of stock solution and left to react in the dark for 30 min, as described by Thapong with some modifications. The analyses were done in three replications and the DPPH antioxidant activity was determined spectrophotometrically.

For microbial analyses 10 g of dehydrated fermented cabbage juice and 10 g of fermented cabbage juice were diluted in 90 ml sterile saline (85% NaCl) and homogenised with a stomacher (Bagmiser Interscience, Bois Arpents F.) for 1 min at 8 strokes per second using internal filter bags. A 1 ml and 0.1 ml of filtrate was plated on petri dishes. Scharlau brand selective media were used, all sterilised in an autoclave. For total plate counts, agar PCA (Ref.no. 01-161-500) was used, and for lactic acid bacteria – MRS agar (ref.nr. 01-135-500). The samples were incubated as follows: PCA 30 °C 48 h; MRS 37 °C 72 h. Enumeration was carried out on an Acolyte colony counter.

Statistical analyses. Data were analysed using one factor analyses of variance (ANOVA), significant differences between the means were determined by Duncan's multiple range test. Pearson correlation coefficients were calculated using Excel software (Microsoft).

RESULTS

The composition of fermented cabbage juice was as follows: dry matter 8%, pH 2.66, NaCl 1.24%, titratable acid $0.33 \text{ g} \cdot 100 \text{ g}^{-1}$ and ascorbic acid $52 \text{ mg} \cdot 100 \text{ g}^{-1}$, and total phenol concentration $743.51 \text{ mg} \cdot 100 \text{ g}^{-1}$. The lactic acid bacteria count in fermented cabbage juice was $14 \cdot 10^4 \text{ CFU} \cdot \text{g}^{-1}$. Physical and chemical characteristics of dehydrated fermented cabbage juice are presented in Table 1. The dehydrated fermented cabbage juice sample with no MD (4MD0) added had the highest salt ($14.31 \pm 0.07 \text{ g} \cdot 100$

g^{-1}) and titratable acid concentration ($0.44 \pm 0.13 \text{ g} \cdot 100 \text{ g}^{-1}$). Moisture content ranged from $5.3 \pm 0.23\%$ in sample 2MD10 to $7.04 \pm 0.02\%$ in sample 3MD5. Water activity was the highest in sample 1MD10 ($a_w = 0.21$) and the lowest in sample 4MD0 ($a_w = 0.183$). Solubility in water ranged from $81.74 \pm 0.66\%$ in sample 1MD10 to $82.8 \pm 0.21\%$ in sample 3MD5.

Organic acid profile. In total, six organic acids were identified in fermented cabbage juice and in dehydrated fermented cabbage juice (Fig. 1). Mallic and ascorbic acids were present in relatively lower amounts in dehydrated fermented cabbage juice, ranging $0.19\text{--}0.44 \text{ g} \cdot 100 \text{ g}^{-1}$ malic acid to $0.02\text{--}0.07 \text{ g} \cdot 100 \text{ g}^{-1}$ ascorbic acid. There was an effect of MD on relative breakdown of organic acids. For, example oxalic acid concentration ranged from $12.4 \text{ g} \cdot 100 \text{ g}^{-1}$ in sample MD10 to $21.84 \text{ g} \cdot 100 \text{ g}^{-1}$ in sample MD0) and acetic acid concentration from $11.15 \text{ g} \cdot 100 \text{ g}^{-1}$ in sample MD10 to $16.5 \text{ g} \cdot 100 \text{ g}^{-1}$ in sample MD0.

Total phenol concentration and antiradical activity. Total phenol concentration and antiradical activity extraction results are shown in Figure 2.

In the samples with no MD added, the phenol concentration was $738 \pm 20 \text{ mg GAE} \cdot 100 \text{ g}^{-1}$ dry weight (dw) in water extracts and $870 \pm 66 \text{ mg GAE} \cdot 100 \text{ g}^{-1}$ dw in acidified ethanol extracts. In the sample 2MD10 the total phenol concentration was $339 \pm 22 \text{ mg GAE} \cdot 100 \text{ g}^{-1}$ in water extracts and $355 \pm 20 \text{ mg GAE} \cdot 100 \text{ g}^{-1}$ dw in acidified ethanol extracts.

Antiradical activity assessed by DPPH showed highest activity with no MD additive — $574 \pm 4 \text{ mg TE} \cdot 100 \text{ g}^{-1}$ water extraction and $577 \pm 52 \text{ mg TE} \cdot 100 \text{ g}^{-1}$ dw acidified ethanol extraction, compared to MD 10% additive 387 ± 28

Fig. 1. Profile of four major organic acids in dehydrated fermented cabbage juice.

Fig. 2. Total phenol concentration (a) and antiradical activity (DPPH (b); ABTS⁺ (c) assay) extraction results, expressed as dry weight (dw), mg·100 g⁻¹. Values with different letters are significantly different.

TE·100 g⁻¹ and 211 ± 50 mg TE·100 g⁻¹ dw, respectively. ABTS was higher with acidified ethanol extraction and no MD additive.

Microbial parameters. Samples with 5% or 0% of MD additive showed higher lactic acid bacteria counts compared to samples with 10% MD additive, as shown in Figure 3.

DISCUSSION

In the analysed samples of dehydrated fermented cabbage juice (powder), NaCl concentration ranged from 8.7 g·100

Fig. 3. Lactic acid bacteria in dehydrated fermented cabbage juice.

g⁻¹ in samples with 10% MD to 14.31 g·100 g⁻¹ in samples with no coating agent (4MD0), which can be explained by the dilution of concentration. This NaCl concentration is considered to be as high, according to EU regulations (EU Science HUB, Health Promotion and Disease Prevention), and thus dehydrated fermented cabbage juice can be used in food formulations to replace salt. According to Latvian legislation (Regulation of Cabinet of Minister), the final content of additional salt in meat products is 1.25 g per 100 g, and therefore the powder without coating agent could be added up to 9%, if acceptable for other quality parameters.

For all the powder samples, water activity was sufficiently stable to inhibit development of microorganisms (below 0.77, FAO), but the parameters are influenced by the use of MD. Lower water activity occurred in the samples with no coating agent added.

The inverted results between water activity and moisture can be explained by the coating agent causing a change in the properties of powder (food components), like flowability, structure and surface activity, which determine water activity. Also, the oven drying method for determining moisture content may have caused a Maillard reaction producing water (Mathlouthi, 2001) in samples with less or no coating agent.

Solubility in water was characterised as good (high solubility considered 97%) (Avila *et al.*, 2015) and was 81.7–82.6% in the samples. No significant effect of MD influence was observed, and based on this parameter, the product was considered to be suitable for further use in food and cosmetic production. In comparison, the solubility of litchi juice powder was found to be 68.11 (Kalita *et al.*, 2018).

There was slight effect of MD on titratable acid concentration, shown by a significant difference of MD0 from the other treatments.

The organic acid profile can be affected by many factors, such as the fermentation process, the state of raw material, types of microorganisms and many other (Shukla *et al.*, 2010). Organic acids formed via metabolism of large mo-

lecular mass compounds influence the taste and aroma of fermented products (Shukla *et al.*, 2010). Oxalic and ascorbic acids are also naturally present in the raw cabbage, while other organic acids, such as lactic, acetic, formic and succinic acid are formed during fermentation (Drašković Berger *et al.*, 2020). The intake of oxalic acid in European diets was estimated to be in the range of 5 mg to 500 mg per day, seasonally exceeding 1000 mg per day, since it occurs in green leafy vegetable consumed during the growing season (EMEA, 2003). In our study, concentration of oxalic acid was 12.40 (MD10) to 21.84 (MD0) g·100 g⁻¹.

In our study, total phenol concentration and antiradical activity were determined in water extract from dehydrated fermented cabbage juice, since the future applied use of the powder (meat; bread production) would be a dilution in water. Acidified ethanol extraction was used as in previous studies (Gouw *et al.*, 2017) to assess the possibility of obtaining higher phenol concentration and antiradical activity. The results show a strong correlation between the methods ($r = 0.67$ for DPPH, $r = 0.93$ ABTS⁺; $r = 0.97$ TPC), and total phenol concentration was also significantly correlated with antioxidant activity ($r = 0.83$ – 0.89), which indicates that TPC reflects antioxidant activity.

Our study showed significant effect ($p < 0.05$) of maltodextrin on total phenol concentration using both extraction methods. In the samples with no MD added, the phenol content was 738 ± 20 mg·100 g⁻¹ dw in water extracts and 870 ± 66 mg GAE·100 g⁻¹ dw in acidified ethanol extracts. In sample MD10 the total phenol content was 339 ± 22 mg GAE·100 g⁻¹ in water extracts and 355 ± 20 mg GAE·100 g⁻¹ dw in acidified ethanol extracts. It is not always the case that the coating agent will maintain the total phenolic concentration and free radical scavenging activity (Shishir and Chen, 2017) with higher concentration. Compared to several vegetable by-product powders (freeze dried and milled), total phenol concentration for white cabbage cut-offs was 341 mg GAE·100 g⁻¹ dw, and for cauliflower cut-offs — 402 mg GAE·100 g⁻¹ dw (Wijngaard *et al.*, 2009). In our study, samples of horizontally spray dried sauerkraut juice showed higher total phenol content.

Antiradical activity assessed by DPPH showed the highest activity with no MD (4MD0) addition 574 ± 4 mg TE·100 g⁻¹ dw in water extracts and 577 ± 52 mg TE·100 g⁻¹ dw in acidified ethanol extracts, compared to samples with MD 10% addition: 387 ± 28 TE·100 g⁻¹ dw and 211 ± 50 mg TE·100 g⁻¹ dw, respectively. For other vegetable powders, the DPPH activity was 284 mg TE·100 g⁻¹ dw for white cabbage cut-offs and 200 mg TE·100 g⁻¹ dw for cauliflower cut-offs (Wijngaard *et al.*, 2009).

The stability of total phenolic concentration and antiradical activity is affected by the choice of the coating agent and spray drying technique. For the retention of heat sensitive compounds, the inlet and outlet temperature are of great importance (Fang and Bhandari, 2011). Previous studies (Kha *et al.*, 2010; Fang and Bhandari, 2011; Krishnaiah *et al.*, 2014) have suggested that the optimum parameters for

spray-drying process to preserve TPC and antiradical activity is outlet temperature 120 °C and 10% (wet weight) maltodextrin. Increased MD concentration results in decrease of total antioxidant activity (Krishnaiah *et al.*, 2014). Feed flow affects antioxidant compounds and moderate flow (7.5 ml·min⁻¹) can promote antioxidant activity (Romano *et al.*, 2020). There is no large impact of time and storage temperature on TPC and antiradical activity for spray-dried non-juice and grains, but for bayberry powder (Fang and Bhandari, 2011) these factors are negatively associated with total phenolic retention rates.

In order to determine the benefits of spray-drying of fermented cabbage juice, we tested the viability of microorganisms in dehydrated fermented cabbage juice, in relation to addition of maltodextrin. According to FAO, WHO (2006) a functional food with a probiotic potential should reach at least 10^7 CFU·g⁻¹. In our study, dehydrated fermented cabbage juice did not meet this standard. There was a major impact of maltodextrin in our samples on bacterial counts, with a range from $8.9 \cdot 10^3$ in MD10 to $4.2 \cdot 10^4$ in MD0 samples. Similar results were reported for kefir powder (Teijeiro *et al.*, 2018).

A combination of effects influences the viability of microorganisms — heat, mechanical stress, pre- and post-processing, the use of coating agents, storage (Medeiros *et al.*, 2014; Dianawati *et al.*, 2016; Kalita *et al.*, 2018; Teijeiro *et al.*, 2018). Kalita *et al.* (2018) observed that cell viability decreased during storage using MD as a coating agent — the survival of *L. plantarum* decreased significantly in lichi juice powder, compared to MD – pectin and MD – fructo-oligosaccharide as coating agents. However, Medeiros *et al.* (2014) and Teijeiro *et al.* (2018) observed that survival of lactic acid bacteria (LAB) was better when spray-dried with a coating agent and maltodextrin had the best effect. This is in contrast with our study, where samples with 5% and 0% of MD addition show better survival of LAB. There was a strong (0.98) correlation between LAB and total plate count. Kalita *et al.* (2018) also observed that pH of around 4 had less severe effect on probiotic organisms than pH of 2. Teijeiro (2018) stated that for kefir powder the combination of whey permeate and maltodextrin and neutral pH (7) resulted in better lactic acid bacteria survival, and suggested that the acidic conditions during dehydration of kefir-derived lactobacilli was the main factor affecting their survival.

CONCLUSIONS

Production of dehydrated fermented cabbage juice is a new application of food waste and therefore quality evaluation is essential. The current experiments utilised horizontal spray-dryer with maltodextrin as a coating agent. There were many factors that influenced the outcome of fermented cabbage and its juice powder as the end product. Maltodextrin and its concentration played an important role in the drying process and the properties of the final product — powder.

Based on previous studies conducted with malt drink, which is physically similar to sauerkraut juice, spray drying was chosen as the most effective drying technology.

Our findings showed that dehydrated fermented cabbage juice is not a source of probiotics, although NaCl and organic acids in fermented cabbage juice may be a good salt and taste additive.

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HORIZONTĀLĀ TIPĀ IZSMIDZINĀŠANAS KALTĒ IEGŪTĀ SKĀBĒTU KĀPOSTU SULAS PULVERA KVALITATĪVIE RĀDĪTĀJI

Skābētu kāpostu pārstrādes procesā veidojas ~30% skābētu kāpostu sula, kas, tāpat kā skābēti kāposti, ir bagāta ar bioloģiski aktīviem savienojumiem. Pārfašēšanas un realizācijas rezultātā daļa skābētu kāpostu sulas paliek neizmantota un tiek utilizēta kā atkritumprodukts. Meklējot risinājumus ilgtspējīgai un bezatlikumu tehnoloģiju ieviešanai pārstrādes uzņēmumos, kā viens no produktiem tiek pētīts dehidrēts skābētu kāpostu sulas pulveris. Šī pētījuma mērķis bija noskaidrot dehidrētas skābētu kāpostu sulas fizikālos (pH, mitruma saturs, ūdens aktivitāte, šķīdība), ķīmiskos (titrējamās skābes, organisko skābju sastāvs, sāls saturs, kopējo fenolu daudzums un antiradikālā aktivitāte) un mikrobioloģiskos (pienskābes baktērijas) rādītājus. Pētījuma gaitā skābētu kāpostu sula tiek izsmidzināta horizontālā tipa izsmidzināšanas kaltē, kā nesējvielu izmantojot maltodekstīnu (MD) dažādās koncentrācijās (0; 5; 10%). Mitruma saturs un ūdens aktivitāte ir atbilstoša, lai inhibētu mikroorganismus. Sāls saturs ir robežās no 8,9% (paraugos ar 10% MD) līdz 14,3 % (0 % MD), šķīdība ūdenī attiecīgi 82,8% – 81,74 %. Kopā tika identificētas sešas organiskās skābes — skābeņskābe, hinskābe, pienskābe, etiķskābe kā arī nelielos daudzumos askorbīnskābe un ābolskābe. Nesējvielas koncentrācija ietekmē kopējo fenolu un antiradikālo aktivitāti dehidratētā skābētu kāpostu sulā, labāki rezultāti ir paraugos ar 0% MD piedevu. Arī pienskābes baktēriju skaits mūsu pētījumā ir lielāks paraugos, kas kaltēti bez nesējvielām.