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EXTRAGEREA FRACŢIILOR PROTEICE DIN ZER PRIN APLICAREA PROCESELOR ELECTROFIZICE

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REZUMAT

Teza de masterat: ***"Extragerea fracţiilor proteice din zer prin aplicarea proceselor electrofizice",*** prevede soluţionarea problemei utilizării subproduselor din industria lactatelor, şi

anume, a zerului prin extragerea concentratelor proteice minerale la procesarea electrofizică a zerului, metodă non-reziduală şi non reagentă care permite valorificarea tuturor componentelor zerului.

Scopul şi Obiectivele lucrării sunt: extragerea concentratelor proteice minerale(CPM) cu conţinut proteic predeterminat în dependenţă de regimurile de procesare (consumul de energie, valorile pH şi a potenţialului de oxido-reducere (POR), temperaturii, durata de procesare) şi stabilirea mecanismelor de formare a compuşilor proteici; analiza metodelor moderne de prelucrare a zerului; caracteristica fracţiilor proteice ale zerului şi obţinerea CPM cu conţinut proteic predeterminat la procesarea electrofizică; cercetarea extragerii CPM în dependenţă de regimurile de procesare (consumul de energie, valorile pH şi POR, temperaturii, durata de procesare); determinarea conţinutului fracţiilor proteice majore extrase în CPM; stabilirea mecanismelor de extragere a fracţiilor proteice în CPM; analiza calităţii materiei prime şi a produselor finale.

Metodologia, pentru realizarea scopului şi obiectivelor propuse s-a selectat electrolizorul cu diafragmă EDP-2, care a permis electroactivarea zerului la diferite densităţi a curentului electric ($j = 10 – 20$ mA/cm^2),înregistrarea şi analiza parametrilor: electrici (voltajul, U (V)); termici (temperatura în faza lichidă şi faza spumoasă, t, ^oC); fizico-chimici (pH şi POR (potenţialul de oxido-reducere) şi biochimici (gradul de extragere a conţinutului proteic total în CPM, (Q, %); gradul de extragere a conţinutului proteic solubil în anumite soluţii tampon, (Qs, %), gradul de extragere a fracţiilor proteice majore în CPM, (Qp, %)); în calitate de lichid de lucrus-au utilizat trei tipuri de zer obţinute după fabricarea: brânzei granulate „Grăuncior”; brânzei de vacă, cu conţinutul de grăsime 2% ; „produsului de brânză”, cu conţinutul de grăsimi 18%; calitatea zerului şi a concentratelor proteice minerale a fost evaluată prin determinarea mai multor parametri biochimici (conţinutul aminoacizilor, conţinutul produselor de oxidare a grăsimilor (conjugatele dienice şi trienice, dialdehida malonică), indicele pepsin-pancreatic); studiul fracţiilor proteice majore extrase în concentratele proteice minerale a fost realizat cu SDS-PAAGE 15% .

Rezultatele, Procesarea electrofizică a zerului a permis identificarea mai multor fracţii proteice conţinutul cărora variază în dependenţă de consumul de energie, volumul de zer procesat, durata procesării, variaţia valorilor pH şi a potenţialului de oxido-reducere (POR). Convenţional aceste fracţii au fost divizate în patru grupe: proteine cu masă moleculară mare (HWP)ce se extrag în dependenţă de tipul zerului procesat şi variază de la 3-34%, având un caracter neuniform; caseinele (CSN)caredepinde de prezenţa lor în ZI şi are un caracter neuniform de recuperare (5-30 %); β-lactoglobulina (β-Lg) ce atinge un maxim de extragere în CPM din primele minute de procesare (de circa 70 %) şi descreşte pe durata procesării până la 20%; α-lactalbumina (α-La)ce are un caracter ascendent de acumulare în CPM de la 10%, ce creşte spre finele procesării (circa 70 %).

Principalele concluzii ale studiului, procesarea electrofizică a zerului prezintă un proces non-rezidual ce permite obţinerea concentratelor proteice minerale (CPM) cu o valoare biologică înaltă şi conţinut proteic predeterminat. A fost demonstrată calitatea produselor finale obţinute la procesarea electrofizică a zerului, confirmată prin prezenţa tuturor fracţiilor proteice din zer şi a conţinutului aminoacizilor, în deosebi, acelor esenţiali; valoarea biologică înaltă, datorită indicelui pepsine-pancreatic înalt - 58; prezenţa lipidelor şi a produselor oxidării lor, ce este sub normă admisibilă. A fost elaborată şi prezentată schema tehnologică de obţinere a concentratelor proteice minerale la procesarea electrofizică a zerului.

SUMMARY

The masterthesis ***"Extraction of whey protein fractions by the electrophysical method"*** provides the solution to the problem of the use of by-products of the dairy industry, namely, whey, by

extraction of mineral protein concentrates in the electrophysical processing of whey, a non-residual and non-reactive method which allows harnessing all whey components.

The purpose and objectives are: extraction of protein mineral concentrates (PMC) with predetermined protein content in relation to the processing regime, with the account of the energy consumption, values of pH and of the oxidation-reduction potential (ORP), duration of processing; determination of the mechanisms of the formation of protein compounds; the analysis of modern whey processing methods; the characteristic of whey protein fractions and obtaining of PMCs at electrophysical processing; determination the content of major protein fractions extracted into the PMC; determination of the mechanisms for extracting protein fractions in PMCs; theanalysis of the quality of raw materials and final products.

The methodology was: n order to reach the proposed goal and objectives, an EDP-2 diaphragm electrolyzer has been selected, which allowed the electro-activation of the whey at different electrical current densities (j = 10 - 20 mA/cm2), recording and analysis of the following parameters: voltage, U (V), temperature in the liquid phase and the foam phase (t, ^{o}C), pH (acid activity), ORP, the degree of extraction of total protein content in PMCs, (Q,%), thedegree of extraction of soluble protein content in certain buffer solutions (Q_s,%), the degree of extraction of major protein fractions in PMCs, (Q_p,%). The research was conducted with three types of whey after the manufacture of the: granulated cottage cheese „Grăuncior", „Cottage Cheese", 2% fat content, and „Curd product", 18% fat content. The quality of whey and PMCs was evaluated by determining several biochemical parameters: amino acid content, content of fat oxidation products, pepsin-pancreatic index; the study of major protein fractions extracted in PMCs was investigated by SDS-PAGE 15%.

Electrophysical processing of whey allowed the identification of several protein fractions, the content of which varies depending on the energy consumption, the volume of processed whey, the duration of processing, the variation of the pH values and of the ORP.

Traditionally, these fractions make up four groups: high weight proteins extracted depending on the type of processed whey and vary within 3-34%, are isolated uniformly during processing; caseins, whose isolation depends on their presence in the initial whey and has an uniformly recovery (5-30%); β-Lg whose isolation is significant in all of the collected samples, even during the first 5 minutes of processing (about 70%) and decreases during processing to 20% ; α-La which has an ascending character of isolation in PMCs of 10%, increasing to the end of processing (about 70%).

Electrophysical processing of whey is a non-residual process that allows the production of PMCs with a high biological value and predetermined protein content. The quality of final products obtained in electrophysical whey processing has been demonstrated, confirmed by the presence of all whey protein fractions and the amino acids content, especially those essential ones; high biological value due to the high pepsin-pancreatic index - 58; the presence of lipids and their oxidation products, which is acceptable. The technological scheme for obtaining PMCs via electrophysical processing of whey was elaborated and is presented.

CUPRINS

INTRODUCERE

Creşterea necesităţilor alimentare induce problema creării noilor procedee şi tehnologii de procesare cu folosirea la maximum atât a materiei prime şi prelucrarea produselor secundare, cât şi reexaminarea utilizării reziduurilor. O astfel de viziune se aplică în industria de prelucrare a laptelui, şi anume, la utilizarea produselor lactate secundare. Elaborarea tehnologiilor fără deşeuri şi prelucrarea non-reziduală a zerului prezintă o problema primordială globală.

Numai cu două decenii în urmă zerul era considerat produs rezidual de o culoare slab verzuie, cu un gust puţin apetisant, care se oxidează destul de rapid datorită valorii înalte a indicilor de oxidare (întrebuinţare biochimică şi chimică a oxigenului, pentru zer este 5) [1]. Pentru companiile de prelucrare a laptelui zerul nu prezenta nici un interes şi circa 50% se arunca în apele reziduale, aducând mari pagube mediului înconjurător. Zerul, deşi este considerat un produs rezidual, are o componenţa valoroasă: lactoză, proteine, componente minerale, lipide, şi alte ingrediente, ce conţin circa 200 de componente şi după lungi dezbateri ale specialiştilor, zerul a fost reclasificat din deşeu al producţiei lactatelor în produs lactat secundar, datorită valorii biologice înalte pe care o posedă, depăşind după unii indici, chiar şi pe cea a laptelui [2]. Prelucrarea non-reziduală a zerului este o problemă complexă din punct de vedere tehnic şi tehnologic, dar de o importanţă majoră pentru toate ţările, inclusiv şi Republica Moldova.

Conţinutul solid al zerului este de 7-8%, şi constituie 50-70% din cel al laptelui iniţial. În zer din lapte trece aproape toată lactoza şi cele mai preţioase fracţii proteice (α-lactalbuminele, β-lactoglobulinele, γ-imunoglobulinele), care nu sunt reţinute în produsele lactate primare, precum şi o serie de macroelemente, microelemente şi vitamine [3]. Produsele lactate secundare şi derivatele sale pot fi utilizate în diferite formule alimentare, pentru furajarea animalelor, precum şi pentru diferite scopuri tehnice (industria chimică, farmaceutică, textilă, etc.). Concentratele proteice extrase din produsele lactate secundare au o gamă largă de utilizare în diferite ramuri precum cea farmaceutică, alimentară, la fabricarea produselor dietetice. Conţinutul mineral şi combinările sale cu proteinele, sunt diverse şi benefice pentru producţia alimentară şi cea farmaceutică,. Zerul, astfel, reprezintă un produs alimentar deosebit de valoros, ce corespunde concepţiei unei alimentaţii balansate şi adecvate.

Valoarea energetică a zerului în comparaţie cu cea a laptelui integru (100%), a laptelui degresat (51%) şi a zarei (58%) constituie 36% faţă de cea a laptelui integru. Valoarea biologică a zerului este condiţionată de prezenţa glucidelor, proteinelor, lipidelor, sărurilor minerale, vitaminelor, substanţelor azotoase neproteice, enzimelor, microelementelor, etc. [4].

Procesarea zerului este diversă şi cuprinde diferite metode şi/sau combinarea acestora, ce permit extragerea tuturor fracţiilor utile din zer. Una dintre metode, descrisă în continuare în teză, este procesarea electrofizică ce are la bază activarea electrochimică sau electroactivarea.

Proteinele, datorită proprietăților lor biologice și nutriționale valoroase prezintă un interes sporit la utilizarea lor atât în industria alimentară, cât și cea farmaceutică. Datorită potenţialului ridicat al zerului în calitate de materie primă valoroasă pentru obţinerea alimentelor şi substanţelor bioactive cu valoare adăugată, elaborarea noilor tehnologii de reutilitate a subproduselor din industria laptelui devine tot mai actuală. Tehnologiile avansate, cum ar fi utilizarea membranelor (osmoza reversă, diafiltrarea, macro- și microfiltrarea, ultrafiltrarea și nanofiltrarea), bio-fermentarea, hidrolizarea, electrodializa, electroactivarea, au făcut posibilă reutilizarea zerului.

Scopul lucrării este extragerea concentratelor proteice minerale (CPM) cu conţinut proteic predeterminat în dependenţă de regimurile de procesare (consumul de energie, valorile pH şi a potenţialului de oxido-reducere (POR), temperaturii, durata de procesare) şi stabilirea mecanismelor de formare a compuşilor proteici.

Obiectivele lucrării sunt:

1. Analiza metodelor moderne de prelucrare a zerului;
2. Caracteristica fracţiilor proteice ale zerului şi obţinerea CPM cu conţinut proteic predeterminat la procesarea electrofizică;
3. Cercetarea extragerii CPM în dependenţă de regimurile de procesare (consumul de energie, valorile pH şi POR, temperaturii, durata de procesare) ;
4. Determinarea conţinutului fracţiilor proteice majore extrase în CPM;
5. Stabilirea mecanismelor de extragere a fracţiilor proteice în CPM;
6. Analiza calităţii materiei prime şi a produselor finale.

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