

Research Of The Application Of The Fat Of The Margarine Industry In The Production Of Margarine Obtained On The Basis Of The Process Of Hydrotransesterification

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Abstract: Solid fats come mainly from animal fats or vegetable oils in the form of hydrogenated oil with a melting point of 36-43 by hydrogenation with hydrogen in the presence of catalysts. The following raw materials were used for the study: Nisosel-820 catalyst containing 25% nickel metal from the Netherlands, a single-use catalyst with a reduced activity of 30%; beef fat with melting point 26 °C; cottonseed oil with a iodine content of 112% and dry hydrogen gas were obtained. The hydrogenated oil was obtained on the basis of the following technology: cottonseed oil and beef fat were first selected in a ratio of 50:50. In this experiment, we can see that 20 °C 29% and 38% of the 1st and 2nd samples have curves, and in general the minimum crystallization requirement is that the amount of solid triglyceride at 20 °C should not be less than 23%. This means that the obtained hydrotransesterification parameters satisfy the law.

Key words: hydrogenated oil, hydrotransesterification, margarine, melting point, catalyst, iodine number

Kirish. Respublikamiz miqyosida margarin ishlab chiqarish hajmi kundan kunga ortib bormoqda. Ma'lumki margarin ishlab chiqarish uchun asosiy hom-ashyo qattiq yog'lar hisoblanadi [2]. Qattiq yog'lar asosan hayvon yog'laridan yoki o'simlik moylarini vodorod bilan katalizatorlar ishtirokida gidrogenlab 36-43 °C erish haroratli salomaslar ko'rinishida bo'ladi [9]. Gidrogenizatsiya jarayoni to'g'ridan-to'g'ri o'simlik moylarining qo'shbog'larga ega yog' kislotasining katalizatorlar ishtirokida vodorod bilan to'yinishi jarayonidir [8]. Albatta bu jarayon salomas ishlab chiqarishning bugungi kunda eng qulay usullaridan hisoblansada, bir qator kamchiliklarga ham ega [7]. O'simlik moylarini katalizator ishtirokida to'yintirishi natijasida trans izomerlar hosil bo'lib bu inson organizmi va salomatligi uchun havfli hisoblanadi. Bu borada O'zbekiston Respublikasi Prezidentining PQ farmoni bilan 2020 yil 4 dekabrda yog'-moy sanoati margarin sanoati davlat standartiga o'zgarish kiritilib, iste'mol qilinadigan margarin mahsuloti tarkibida trans kislota (trans izomer) miqdori 2 % dan oshmasligi belgilab qo'yildi [1,10]. Dunyo miqyosida trans izomerlardan holi yog'lar ishlab chiqarish uchun gidrogenlangan yog'larni, suyuq o'simlik yoki hayvon yog'lari bilan kimyoviy pereeterifikatsiyalash yo'li bilan margarin xom ashyosi hisoblangan yog'larni olish birmuncha yo'lga qo'yilgan [11,12]. Pereeterifikatsiya jarayonida asosan C₂H₅ONa, CH₃ONa va ishqoriy metallardan foydalaniladi [16]. Yevropa davlatlarida bu turdagi yog'larni ishlab chiqarishda fermentativ pereeterifikatsiya jarayonidan ko'proq foydalaniladi, chunki jarayon umuman bezarar bo'lib, kimyoviy katalizatorlardan holi bo'lgan biologik katalizatorlardan ya'ni asiltransferaza, lipaza fermentlaridan foydalaniladi [14,15]. Asosan respublikamizda trans izomerlar miqdori kam bo'lgan salomaslar ishlab chiqarishlari bir muncha kam va yetishmaydi desa ham bo'ladi. Respublikada keng hajmli margarin ishlab chiqaruvchi korxonalar deyarli hammasi quyidagi pereeterifikat, salomas va sut yog'i o'rinbosarlarini xorijdan valyuta hisobiga olib kelishadi [6,13]. Quyida: Cargill 36, Cargill 39, Efko 36, AIDA 39 yog'lari shular jumlasidandir. Margarin ishlab chiqarish bo'yicha respublikamizning Toshkent shahrida QK MChJ "Milk Euro Food", "GOOD FOOD GROUP" MChJ, "CHROMOS PRODUCTION" XK korxonalarida yiliga 50000 tonnadan ortiq

xorijdan valyuta hisobiga keltirilgan yog'lar ishlatiladi [3]. Bu hajmni qisman bo'lsada qisqartirishga biz gidropereeterifikasiya jarayonini qo'llab, erish haroratlari margarin sanoati yog'lariga yaqin bo'lgan yog'larni olish tadqiqotini taklif qildik [4].

Tadqiqot obyekti va uslublari. Tadqiqot olib borish uchun quyidagi xom ashyolardan foydalanildi: Gollandiyadan keltirilgan tarkibida 25 % nikel metalini ushlagan Nisosel-820 katalizatorining bir marta ishlatilib aktivligi 30 % ga tushgan katalizator; erish harorati 26 °C bo'lgan mol yog'i; yod soni 112 % bo'lgan paxta moyi va quruq vodorod gazi olindi. Gidropereeterifikat quyidagi texnologiya asosida olindi: oldin 50:50 nisbatda paxta moyi va mol yog'i tanlab olinib, mol yog'i eritilgan holatda paxta moyi bilan aralashtirib hajmi 11 bo'lgan vodorod bprbotajli konussimon avtoklavga solindi va tashqi kamerasiga nixrom tola orqali elektr toki yordamida qizdirilib aralashma harorati 180 °C gacha qizdirilib, ishlab chiqqan nisosel-820 katalizatori kukun holatgacha maydalanib avtoklav mahsus joyidan berildi. Gidropereeterifikasiya uchun olingan yog'lar aralashma og'irligi 400 gr ga keltirilib olindi va 30 % aktivlikli katalizatorni aralashma massasiga nisbatan 0,2 % miqdorda hisoblab avtoklavga vodorod berishni boshladik. Ma'lum vaqt oralig'ida harorat oshishini kuzatdik va jarayon ekzotermik bo'lgani uchun qizdirishni 185 °C da to'htatganimizdan keyin harorat 205 °C gacha bir necha bor ko'tarildi. Avtoklavda jarayon 1 soat olib borildi va har 20 minutda namuna olib turdik va erish harorati 36 °C ga yetganda jarayonni to'xtatdik. Olingan gidropereeterifikatni 90 °C termostatli mufel isitgichida filtr qog'oz orqali filtrlab, sovitilgan holatdagi oq rangli salomas gidropereeterifikatni oldik va uni margarin resepturasida qo'llab margarin mahsulotida sinab ko'rdik [5].

Olingan natijalar muhokamasi. Tadqiqotlarni olingan gidropereeterifikatning margarin uchun xom-ashyo sifatida mos keluvchi ko'rsatkichlarini aniqlashdan boshladik. Tahlil natijalari shuni ko'rsatadiki olingan yog'ning erish harorati, qattiqligi katalizator aktivligiga, jarayon haroratiga bog'liqligi ma'lum bo'ldi. Margarin emulsiyasi konsistentligi gidropereeterifikatning nisbatan pastroq haroratda to'yintirilishini talab qilar ekan. U holda ishlatilgan katalizatorimiz aktivligi nisbatan ko'proq bo'lishi zarur ekan. Natijalar 1-jadvalda keltirilgan.

1- jadval
Mol yog'i va paxta moyining gidropereeterifikatlari

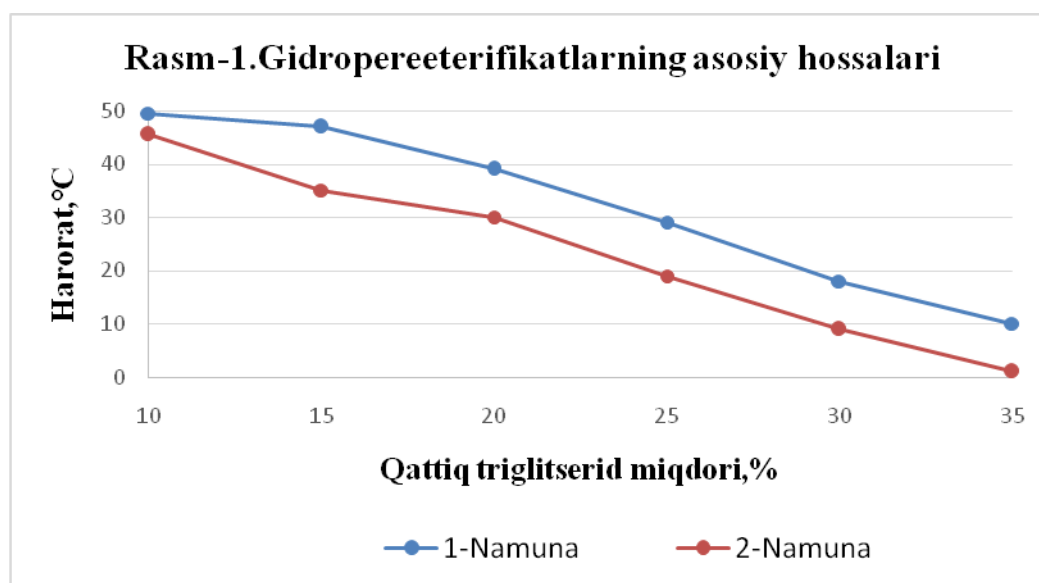
Jarayon va mahsulot ko'rsatkichlari	Aralashma 50:50	
	1-namuna	2-namuna
Harorat, °C	180-190	160-170
Katalizator aktivligi, °C	30	50
Salomas erish harorati, °C	33	36
Salomas qattiqligi, g/sm	130	160-240
Salomas kislota soni, mg KOH	0,5	0,3

1-jadvaldan ko'rinadiki, 1-namunada harorat yuqori bo'lganda katalizator miqdori 2-namuna bilan teng bo'lsada aktivligi kam bo'lgani uchun erish harorati va qattiqligi nisbatan kamroq bo'lib 33 °C va 130 g/sm ni tashkil qildi, 2-namunada harorat bir muncha kamroq bo'lib katalizator aktivligi 50 °C bo'lganda erish harorati 36 °C ni tashkil qilib, qattiqligi 160-240 g/sm orasida bo'ldi. 2-namuna ko'rsatkichlari margarin mahsuloti talabiga javob beradi. 1-chi va 2-chi namunada olingan gidropereeterifikatlarni 82 % va 72 % li margarin resepturasida qo'llab, margarin mahsulotini oldik va quyida reseptni 2-jadvalda keltiramiz.

2- jadval
 Margarin resepturalari

Margarinning komponentlari, %	Retsepturalar		
	1	2	3
Gidropereeterifikat yog', $T_{er.h} 36^{\circ}C$	35,2	31,2	31,2
Gidropereeterifikat yog', $T_{er.h} 33^{\circ}C$	28,4	20,4	20,4
Kungaboqar moyi	8,0	0,0	8,5
Paxta moyi	10,249	20,099	10,099
Salomas, $T_{er.h} 46,9^{\circ}C$	0,0	0,0	1,5
Bo'yoq	0,001	0,001	0,001
Aromatizator	0,09	0,09	0,09
Emulgator	0,2	0,2	0,2
Fosfatid konsentri	0,2	0,3	0,3
konservant (kaliy sorbat)	0,05	0,05	0,05
tuz	0,4	0,4	0,4
shakar	0,4	0,4	0,4
Limon kislotasi	0,02	0,03	0,03
Suv	16,79	26,83	26,83
jami	100	100	100
Umumiy yog'dorlik miqdori	82,25	72,2	72,2

Margarin mahsulotini ishlab chiqarish tajribasidan ma'lumki, yog'li asosning $20^{\circ}C$ dagi qattqlikda trigliseridlar miqdori 16-21 % orasida bo'lishi zarur. Hidropereeterifikatning $36^{\circ}C$ erish haroratidagi qattqligi 160-240 g/sm bo'lganda margarinning dilatometrik tahlilining qattiq trigliserid miqdori tarkibi $20^{\circ}C$ da 29 % va 38 % orasida bo'lishi aks etgan egri chiziqlar bilan 1-rasmda keltirilgan.



Hulosa. Margarin ishlab chiqarishda reseptura tuzish jarayonida ma'lum bir haroratda qattiq trigliseridlar miqdorini (TTG) hisobga olib tuzilsa olinadigan mahsulot konsistentligini birmuncha oldindan qaysi konditer mahsulotda ishlatish diapazonini organoleptik, fizik-kimyoviy ko'rsatkichlarini belgilash mumkin. Margarin mahsulotining sifati to'g'ridan to'g'ri uning asosiy xom-ashyosi bo'lgan salomas, gidropereeterifikat yoki pereeterifikatlarning sifat ko'rsatkichlari orqali o'z tasdig'ini topadi buni 1-rasmda keltirilgan namunalar egri chiziqlari orqali ko'rishimiz mumkin. Mazkur tajribada 1 chi va 2 chi namunalarining $20^{\circ}C$ 29 % va 38 % egri chizlarda ko'rishimiz mumkin, umuman minimal kristallizatsiyalash talabi $20^{\circ}C$ da qattiq trigliserid miqdori 23 % kam bo'lmasligi kerak. Demak olingan gidropereeterifikatlarimiz qonuniyatni qanoatlantiradi.

References

1. O'zbekiston Respublikasi Prezidentning PQ-3408 son qarori. <https://lex.uz/docs/-3429584>
2. Hodjaev S.F., Abdurahimov S.A., Akramova R.R., Hamidova M.O. [The study of quality indicators of the fat base of margarine when replacing traditional cottonseed oil with safflower]. *Universum: Khimiya i biologiya*, 2018, vol.2, no.10, pp.15-18. (In Russ.) Available at: <http://7universum.com/ru/nature/archive/item/6421>
3. Ruzibayev A.T., Salijanova Sh.D., Rakhimov D.P. Cottonseed oil as a valuable raw material to obtain trans-free margarine. *Journal of Critical Reviews*, 2020, vol.7, no.9, pp.572-577. [doi:10.31838/jcr.07.09.114](https://doi.org/10.31838/jcr.07.09.114)
4. Handa. C. Performance and fatty acid profiling of interesterified trans free bakery shortening in short dough biscuit/C. Handa. S. Goomer. A. Sidahu. *International Journal of Food Science & Technology*. 2010. Vol. 45, no. 5, pp.1002-1008.
5. Arutyunyan N.S., Yanova L.I., Arisheva E.A., Kosachev V.S., Kamyshyan M.A. *Laboratory praktikum po tekhnologii pererabotki zhirov* [Laboratory Workshop on Fat Processing Technology]. Moscow, Agropromizdat, 1991. pp.160.
6. Rakhimov D.P., Salijanova Sh.D., Ruzibaev A.T., Achilova S.S., Sanaev E.S.H. Opredeleeniye optimal'nogo temperaturnogo rezhima priokhlazhdenii i kristallizatsii v proizvodstve margarina dlya sloenogo testa [Determination of the optimal temperature regime during cooling and crystallization in the production of margarine for a layered pastry]. *Universum: Khimiya i biologiya*, 2019, vol.66, no.12, pp. 95-100. (In Russ.) Available at: <http://7universum.com/ru/nature/archive/item/8385>
7. Koritala S. Selective hydrogenation of soybean oil. VIII. Effect of method of preparation upon the activity of a copper-silica catalyst. *Journal of the American Oil Chemists Society*, 1977, vol.54, no.6, pp.267-268. [doi:10.1007/BF02655169](https://doi.org/10.1007/BF02655169)
8. Tovbin I.M., Melamud N.L., Sergeev A.G. *Gidrogenizatsiya jirov* [Fat hydrogenation]. Moscow, Legkaya i pischevaya prom.. Publ., 1981. 296 p.
9. Ruzibayev A.T., Kadirov Y.K., Rahimov D.P. Intensification of the hydrogenation process of vegetable oils with effective methods of detoxication of catalyst. *European Applied Sciences*, 2015, no. 5, pp. 58-61
10. Rabinovich L.M., *Gidrogenizatsiya i pereeterifikatsiya jirov* [Hydrogenation and transesterification of fats]. Sankt-Peterburg, Professiya Prud. Publ., 2013. 240p.
11. Botirova M.N., Salidjanova Sh.D., Ruzibaev A.T. [Getting deep hydrogenated fat for margarine production]. *Sbornik statey xxx mejdunarodnoy nauchno-prakticheskoy koferentsii "Sovremennyye tekhnologii"* [Collection of articles xxx of the international scientific-practical conference "Modern Technologies"]. Penza, 2019, pp.13-16.
12. Ruzibaev A.T., Salidjanova Sh.D. Issledovaniya protsessa polucheniya margarina na osnove mestnogo jirovogo syrira [Studies of the process of obtaining margarine based on local fatty raw materials]. *Universum: Tekhnicheskiye nauki*, 2017, vol.43, no.10. (In Russ.) Available at: <http://7universum.com/ru/tech/archive/item/5177>
13. Rahimov D., Ruzibaev A., Tashmurotov A., Salijanova Sh. Research of the process of obtaining interesterified fat for margarine production on the basis of sunflower oil and palm stearin. *Chemistry and Chemical Engineering*, 2020, vol.18, no.1, pp.64-68.
14. Rakhimov D.P., Abdullaev U.S., Rakhimov P.H., Ruzibaev A.T. Getting a modified interesterification using the combination of liquid oils and solid fat. *Austrian Journal of Technical and Natural Sciences*, 2020, n.3-4, pp.3-9. [doi:10.29013/AJT-20-3.4-3-9](https://doi.org/10.29013/AJT-20-3.4-3-9)
15. Oku T. Nonoguchi M. Moriguchi T. [Method of production of fatty acid alkyl esters and/or glycerine and fatty acid alkyl ester-containing composition]. Patent World Organization, 2005021697, 2005.
16. Macierzanka A. Szeląg H. [Esterification kinetics of glycerol with fatty acids in the presence of zinc carboxylates: Preparation of modified acylglycerol emulsifiers](https://doi.org/10.1021/IE040077M). *Industrial and Engineering Chemistry Research*, 2004, vol.24, no.43, pp.7744-7753. doi.org/10.1021/IE040077M