

SCIENCE  
JOURNAL

# MODERN

ENGINEERING AND  
INNOVATIVE  
TECHNOLOGIES

'2023

ISSUE №27

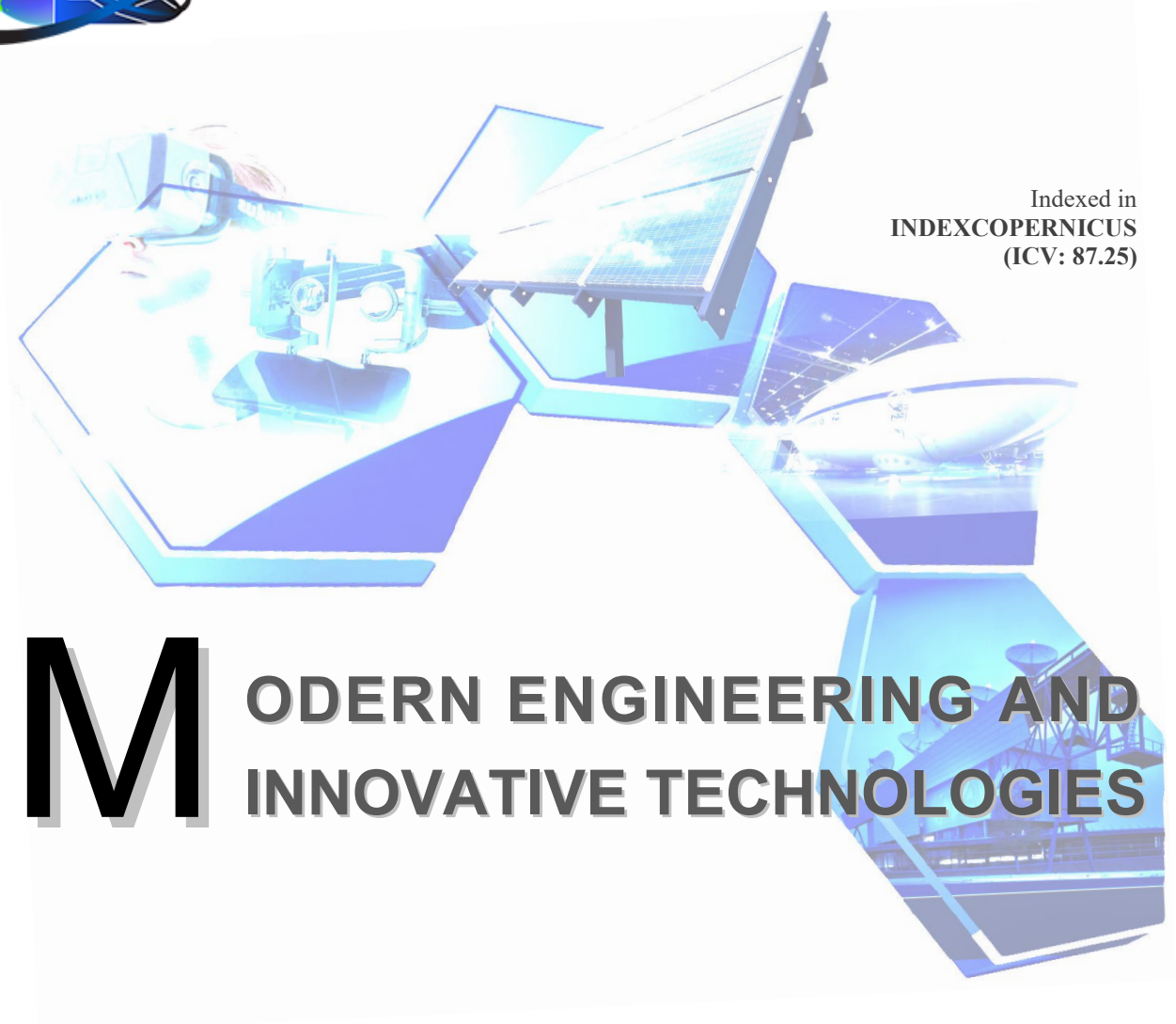
Part №1



*International periodic scientific journal*

—*ONLINE*

*www.moderntechno.de*



Indexed in  
**INDEXCOPERNICUS**  
(ICV: 87.25)

# **M**ODERN ENGINEERING AND INNOVATIVE TECHNOLOGIES

**Issue №27**

**Part 1**

**June 2023**

*Published by:*  
**Sergeieva&Co**  
*Karlsruhe, Germany*

# Editorial Team

**Chief Editor:** *Shibaev Alexander Grigoryevich*, Doctor of Technical Sciences, Professor, Academician

**Deputy Chief Editor:** *Kupriienko Serhii Vasilovich*, Candidate of Technical Sciences

## Editorial Board:

Angelova Polya Georgieva, Doctor of Economic Sciences, Professor - <https://orcid.org/0000-0003-0479-0954>

Antraptseva Nadezhda Mikhailovna, Doctor of Chemical Sciences, Professor - <https://orcid.org/0000-0002-5661-6133>

Ardelian Olena, Candidate of Pedagogica Sciences, Associate Professor - <https://orcid.org/0000-0002-7166-0095>

Bakhmat Natalia Valerievna, Doctor of Pedagogica Sciences, Professor - <https://orcid.org/0000-0001-6248-8468>

Bakushevych Ivanna, Candidate of Economics, Professor - <https://orcid.org/0000-0001-8978-6609>

Baryshnikova Vira Vyacheslavivna, Candidate of Economics, Associate Professor - <https://orcid.org/0000-0002-5068-9884>

Batyrgareeva Vladislava Stanislavovna, Doctor of legal Sciences - <https://orcid.org/>

Belotserkovets Vladimir Viktorovich, Doctor of Economic Sciences, Professor - <https://orcid.org/>

Benera Valentuna, Doctor of Pedagogica Sciences, Professor - <https://orcid.org/0000-0003-2865-3217>

Bilavych Halyna Vasyliwna - <https://orcid.org/0000-0002-1555-0932>

Bodyk Ostap Petrovych, Candidate of philological Sciences, Docent - <https://orcid.org/0000-0003-4642-8371>

Boiko Ruslan Vasiliovich, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0003-1409-846X>

Boiko Viktoriia, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0002-8032-5731>

Bondar Oleksandr Bogdanovich, senior teacher - <https://orcid.org/>

Borovik Liubov Volodymyrivna, Doctor of Economic Sciences, Associate Professor - <https://orcid.org/>

Borovyk Svitlana Serhiyivna, Candidate of technical Sciences - <https://orcid.org/0000-0003-4168-8537>

Brukhansky Ruslan Feoktistovich, Doctor of Economic Sciences, Professor - <https://orcid.org/>

Bunchuk Oksana, Doctor of legal Sciences, Docent - <https://orcid.org/0000-0002-7280-6957>

Burdaev Volodymyr Petrovych, senior researcher - <https://orcid.org/0000-0001-9848-9059>

Bushueva Inna Vladimirovna, Doctor of Pharmaceutical Sciences, Professor - <https://orcid.org/>

Cherusheva Galyna, Candidate of Pedagogica Sciences, Associate Professor - <https://orcid.org/0000-0001-9652-0913>

Chervony Ivan Fyodorovich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Chiladze Georgiy Bidzinovich, Doctor of legal Sciences, Professor - <https://orcid.org/>

Chovhaniuk Olha, Candidate of Medical Sciences, Associate Professor - <https://orcid.org/0000-0002-3867-4620>

Chupakhina Svitlana Vasylivna, Candidate of Pedagogica Sciences, Docent - <https://orcid.org/0000-0003-1274-0826>

Chushenko Valentina Mykolayivna, Candidate of Pharmaceutical Sciences, Docent - <https://orcid.org/0000-0002-1032-9008>

Cuznetov Alexandru Serghei, Candidate of legal Sciences, Docent - <https://orcid.org/0000-0002-2738-5620>

Demidova V.G., Candidate of Pedagogica Sciences, Docent - <https://orcid.org/>

Demyanenko Natalia, Doctor of Pedagogica Sciences, Professor - <https://orcid.org/0000-0001-5932-2862>

Elezovich M. Dalibor, Doctor of historical Sciences, Docent - <https://orcid.org/>

Ermagambet Bolat Toleukhanovich, Doctor of Chemical Sciences, Professor - <https://orcid.org/>

Fedorova Yuliia Hennadiivna, Candidate of philological Sciences, Docent - <https://orcid.org/0000-0001-8325-6439>

Fedoryshyn Dmytro Dmytrovych, Doctor of geological and mineralogical Sciences, Professor - <https://orcid.org/>

Fonar Liudmyla, Candidate of technical Sciences - <https://orcid.org/0000-0002-7478-6742>

Garmash Svetlana Nickolaevna, Candidate of Agricultural Sciences, Docent - <https://orcid.org/0000-0002-2658-162X>

Georgievsky Gennady Viktorovich, Doctor of Pharmaceutical Sciences, senior researcher - <https://orcid.org/>

Gladukh Ievgenii, Doctor of Pharmaceutical Sciences, Professor - <https://orcid.org/0000-0002-5739-9257>

Golub Tetiana, Candidate of Pedagogica Sciences, Associate Professor - <https://orcid.org/0000-0002-7757-880X>

Goncharenko Igor Vladimirovich, Doctor of Agricultural Sciences, Professor - <https://orcid.org/0000-0002-5480-1378>

Gornostaj Oryslava Bogdanivna, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0002-6863-6772>

Granovskaya Lyudmila Nikolaevna, Doctor of Economic Sciences, Professor - <https://orcid.org/>

Grizodub Alexander Ivanovich, Doctor of Chemical Sciences, Professor - <https://orcid.org/>

Gudz Maryna Viktorivna, Doctor of Economic Sciences, Professor - <https://orcid.org/0000-0002-1454-4987>

Gudzenko Alexander Pavlovich, Doctor of Pharmaceutical Sciences, Professor - <https://orcid.org/>

Halatsyn Kateryna Oleksandrivna, Candidate of Pedagogica Sciences, Associate Professor - <https://orcid.org/0000-0003-3297-8284>

Hetman Anatoly Pavlovich, Doctor of legal Sciences, Professor - <https://orcid.org/>

Horshchar Vladyslav Ivanovich, Candidate of Agricultural Sciences, Associate Professor - <https://orcid.org/0000-0001-9175-9749>

Jiri Hlahula, Doctor of geological and mineralogical Sciences, Professor - <https://orcid.org/>

Kafarsky Vladimir Ivanovich, Doctor of legal Sciences, Professor - <https://orcid.org/>

Kalabska Vira Stepanivna, Candidate of Pedagogica Sciences, Docent - <https://orcid.org/>

Kalinichenko Irina Alexandrovna, Doctor of Medical Sciences, Professor - <https://orcid.org/>

Kalinichenko Yevgeniy Vladimirovich, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0003-2898-7313>

Kantarovich Yu.L., Candidate of Art Studies - <https://orcid.org/>

Katerynychuk Ivan Stepanovych, Doctor of technical Sciences, Professor - <https://orcid.org/0000-0002-8634-0916>

Khara Maryna Volodymyrivna, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0002-6818-7938>

Kharkovliuk-Balakina Natalia, Candidate of biological Sciences, Docent - <https://orcid.org/0000-0001-8341-0387>

Khavrova Kateryna, Doctor of Economic Sciences, Associate Professor - <https://orcid.org/0000-0001-9376-0700>

Khodakivska Olga, Doctor of Economic Sciences, senior researcher - <https://orcid.org/0000-0002-3421-8361>

Khomazyuk Tetyana Anastasyevna, Doctor of Medical Sciences, Professor - <https://orcid.org/0000-0002-2368-5116>

Khymai Nataliia Ihorivna - <https://orcid.org/0000-0002-2625-7301>

Kirichenko Alexander Anatolievich, Doctor of legal Sciences, Professor - <https://orcid.org/>

Kirillova Elena Viktorovna, Doctor of technical Sciences, Docent - <https://orcid.org/>

Kirkin Oleksandr Pavlovich, Candidate of technical Sciences, Docent - <https://orcid.org/>

Klymenko Ilona Viktorivna, Candidate of physical and mathematical Sciences, Docent - <https://orcid.org/0000-0001-7018-0922>

Knyazyeva Maryna Vladislavovna - <https://orcid.org/>

Knysh Inna Vasilivna, doctor of philosophical science, Associate Professor - <https://orcid.org/0000-0003-1746-359X>

Kokebayeva Gulzhauhar Kakenovna, Doctor of historical Sciences, Professor - <https://orcid.org/0000-0002-6638-4663>

Kolomiets Tetiana Vyacheslavivna, Candidate of Philosophical Sciences - <https://orcid.org/0000-0002-5335-7789>

Kononenko Mykhailo Mykhaylovych, Candidate of Sciences in public administration, Docent - <https://orcid.org/>

Kononova Alexandra Evgenievna, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0002-7215-8574>

Kopey Bogdan Vladimirovich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Korobeinikova Tetiana I., Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0003-2487-8742>

Kostenko Vasily Ivanovich, Doctor of Agricultural Sciences, Professor - <https://orcid.org/>

Kostyshyn Nataliia Stepanivna, Candidate of Economics, Associate Professor - <https://orcid.org/0000-0003-2736-4843>

Koval Galina, Doctor of Medical Sciences, Professor - <https://orcid.org/0000-0002-0623-2326>

Kovalenko Petr Ivanovich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Kravchenko Oleksandra Anatoliivna, Candidate of technical Sciences - <https://orcid.org/0000-0002-3085-7449>

Kravchenko Olena Ivanivna, Doctor of Pedagogica Sciences, Docent - <https://orcid.org/0000-0002-7955-3542>

Kravchenko Victoria Petrovna, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0003-4343-6296>

Kravchuk Anna Viktorovna, Doctor of Economic Sciences, Professor - <https://orcid.org/>

Kuderin Marat Krykbaevich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Kuhar Elena Vladimirovna, Doctor of Biological Sciences, Docent - <https://orcid.org/>

Kukel Galina Serhiyivna, Candidate of Economics - <https://orcid.org/0000-0001-7699-5997>

Kulikov P.M., Doctor of Economic Sciences, Professor - <https://orcid.org/>

Kuris Yuri Vladimirovich, Doctor of technical Sciences, Professor - <https://orcid.org/0000-0001-7169-9187>

Kurmaev Pyotr Yuryevich, Doctor of Economic Sciences, Professor - <https://orcid.org/>

Kyianovskyi Aleksandr Moiseevich, Candidate of Chemical Sciences, Docent - <https://orcid.org/0000-0001-7291-1303>

Kyselov Iurii Olexandrovyh, Doctor of Geographical Sciences, Professor - <https://orcid.org/0000-0003-0530-1892>

Lapkina Inna Alexandrovna, Doctor of Economic Sciences, Professor - <https://orcid.org/>

Latygina Natalia Anatolievna, Doctor of political science, Professor - <https://orcid.org/>

Lekhan Valeriia N., Doctor of Medical Sciences, Professor - <https://orcid.org/0000-0003-2953-3292>

Maidanyuk Irina Zinovievna, Doctor of Philosophy, Docent - <https://orcid.org/0000-0001-8096-0244>

Makarenko Andriy Viktorovich, Candidate of Pedagogica Sciences, Docent - <https://orcid.org/0000-0003-4885-9706>

Malakhov A.V., Doctor of physical and mathematical Sciences, Professor - <https://orcid.org/>

Malinovskiy Yuriy Alexandrovich, Candidate of technical Sciences, Docent - <https://orcid.org/>

Malyshevska Olha Stepanivna, Doctor of Biological Sciences, Associate Professor - <https://orcid.org/0000-0003-0180-2112>

Matiukha Mykola Mykolajovych, Candidate of Economics, Associate Professor - <https://orcid.org/0000-0002-7968-3777>

Maxine Viktor Ivanovich, Doctor of Chemical Sciences, Professor - <https://orcid.org/>

Mazur Vitalii Hryhorovych, Candidate of Public Administration - <https://orcid.org/0000-0002-8133-7355>

Medynska Tetiana Igorivna, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0001-6838-6403>

Melnik Alena Alekseevna, Doctor of Economic Sciences, Docent - <https://orcid.org/>

Melnyk Marharyta, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0003-0619-7281>

Mikheev Andriy, Candidate of biological Sciences, Associate Professor - <https://orcid.org/0000-0003-2163-8866>

Mirus Oleksandr-Zenovij Lvovich, Candidate of Chemical Sciences, Docent - <https://orcid.org/0000-0002-3916-2360>

Mishchuk Ievgeniia Vladimirovna, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0003-4145-3711>

Mishenina Tatyana Mikhailovna, Doctor of Pedagogica Sciences, Professor - <https://orcid.org/>

Mitina Lubov Sergiivna, Candidate of philological Sciences, Docent - <https://orcid.org/0000-0003-0060-419X>

Morozov Alexey Vladimirovich, Doctor of Agricultural Sciences, Professor - <https://orcid.org/>

Morozov Andrii Serhiiovych, Candidate of technical Sciences, Docent - <https://orcid.org/>

Morozov Oleg Viktorovych, Docent - <https://orcid.org/0000-0002-3484-3570>

Muliar Volodymyr Ilyich, Doctor of Philosophy, Professor - <https://orcid.org/0000-0002-1585-7328>

Myliutchehko Ivan Oleksandrovych, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0001-7559-8850>

Nashynets-Naumova Anfisa, Doctor of legal Sciences, Docent - <https://orcid.org/0000-0002-5811-7733>

Nesterenko Tetiana Mykolaivna, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0001-7900-8512>

Nichuhovska Lilia Ivanivna, doctor of Pedagogica Sciences, Professor - <https://orcid.org/0000-0002-3704-8126>

Nikolaienko Iryna Volodymyrivna, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0002-2933-0498>

Nikolenko Liudmyla, Candidate of Pedagogica Sciences, Associate Professor - <https://orcid.org/0000-0001-8708-3117>

Okhrimenko Viacheslav Mykolaiovich, Docent - <https://orcid.org/0000-0003-4940-7859>

Orlov Nikolai Mikhailovich, Doctor of Public Administration, Docent - <https://orcid.org/>

Otepova Gulfira Yelubayevna, Doctor of historical Sciences, Professor - <https://orcid.org/>

Pakhomova Victoria Nikolaevna, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0002-0022-099X>

Panasyuk Valentyna, Doctor of Economic Sciences, Professor - <https://orcid.org/0000-0002-5133-6431>

Parunakyan Vahagn Emilievich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Patyka Nikolay Vladimirovich, Doctor of Agricultural Sciences, Professor - <https://orcid.org/>

Pavlenko Anatoly Mikhailovich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Pavlenko Olena Panteliivna, Doctor of Economic Sciences, Professor - <https://orcid.org/0000-0002-5493-5798>

Pereginec Ivan Ivanovich, Candidate of technical Sciences, Docent - <https://orcid.org/>

"Peretiaka Serhii

Mykolayovych, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0003-4058-4525>"

Petrosova Valentina Ivanovna, Candidate of biological Sciences, Associate Professor - <https://orcid.org/0000-0001-6256-8003>

Pikas Olha Bohdanivna, Doctor of Medical Sciences, Professor - <https://orcid.org/>

Podchashynskyi Yurii Oleksandrovyh - <https://orcid.org/0000-0002-8344-6061>

Polyakov Andrey Pavlovich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Popova Julia Mikhailivna, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0003-1255-3350>

Pysmenna Olena, Candidate of legal Sciences, Docent - <https://orcid.org/>

Rastrygina Alla Nikolaevna, Doctor of Pedagogica Sciences, Professor - <https://orcid.org/>

Rokochinsky Anatoly Nikolaevich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Romashchenko Mikhail Ivanovich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Sementsov Georgy Nikiforovich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Shablii Tetiana Petrivna, Candidate of Medical Sciences, Docent - <https://orcid.org/0000-0003-3114-3728>

Shaiko-Shaikovsky Alexander Gennadievich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Shalova Natalia Stanislavivna - <https://orcid.org/0000-0003-4719-727X>

Shapovalov Valentin Valerievich, Doctor of Pharmaceutical Sciences, Professor - <https://orcid.org/>

Shapovalov Valery Vladimirovich, Doctor of Pharmaceutical Sciences, Professor - <https://orcid.org/>



Shapovalova Victoria Alekseevna, Doctor of Pharmaceutical Sciences, Professor - <https://orcid.org/>

Sharagov Vasiliy Andreevich, Doctor of Chemical Sciences, Docent - <https://orcid.org/>

Shatkovskiy Andrii, Doctor of Agricultural Sciences - <https://orcid.org/0000-0002-4366-0397>

Shepel Yuri Alexandrovich, Doctor of philological Sciences, Professor - <https://orcid.org/>

Shepitko Valery Yurievich, Doctor of legal Sciences, Professor - <https://orcid.org/>

Shevchenko Larisa Vasilievna, Doctor of Veterinary Sciences, Professor - <https://orcid.org/>

Shibaev Alexander Grigorievich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Shishka Roman Bogdanovich, Doctor of legal Sciences, Professor - <https://orcid.org/>

Shvets Iryna Borysovna, Doctor of Art Studies, Professor - <https://orcid.org/0000-0002-3661-670X>

Shilo Zhanna Stepanivna, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0002-2669-6734>

Slobodianyuk Hanna Valeriivna, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0002-1453-6290>

Smutchak Zinaida Vasylivna, Doctor of Economic Sciences, Docent - <https://orcid.org/0000-0002-6079-9227>

Sopov Dmytro - <https://orcid.org/0000-0002-2684-4688>

Stanislavchuk Oksana Volodymyrivna, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0001-5784-005X>

Stovpets Alexander Vasilievich, Doctor of Philosophy, Docent - <https://orcid.org/0000-0001-8001-4223>

Stovpets Vasily Grigorievich, Candidate of philological Sciences, Docent - <https://orcid.org/0000-0002-2354-2852>

Suima Irina Pavlivna, Candidate of philological Sciences - <https://orcid.org/0000-0002-2209-8614>

Sukhenko Yury Grigorievich, Doctor of technical Sciences, Professor - <https://orcid.org/>

Svitlana Titova, Candidate of Geographical Sciences, Docent - <https://orcid.org/0000-0002-9250-805X>

Sydorovich Maryna Mykhailovna, Doctor of Pedagogica Sciences, Professor - <https://orcid.org/>

Tarariko Yury Alexandrovich, Doctor of Agricultural Sciences, Professor - <https://orcid.org/>

Tatarchuk Tetiana, Candidate of technical Sciences - <https://orcid.org/0000-0002-6408-0463>

Tkachova Oksana Vitaliyivna, Doctor of Pharmacy, Professor - <https://orcid.org/0000-0003-4646-0400>

Tkachuk Andrii, Candidate of technical Sciences, Docent - <https://orcid.org/>

Trigub Petr Nikitovich, Doctor of historical Sciences, Professor - <https://orcid.org/>

Tungushbaeva Zina Baibagusovna, Doctor of Biological Sciences - <https://orcid.org/>

Ustenko Sergey Anatolievich, Doctor of technical Sciences, Docent - <https://orcid.org/>

Vakaliuk Igor P, Doctor of Medical Sciences, Professor - <https://orcid.org/0000-0002-4430-6816>

Vasylyshyn Vitalii, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0002-0367-1198>

Vekua Oksana Vitalevna, Candidate of philological Sciences, Docent - <https://orcid.org/>

Velichko Stepan Petrovich, Doctor of Pedagogica Sciences, Professor - <https://orcid.org/>

Vitroviy Andriy Orestovych, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0003-2885-3745>

Vizir Vadim Anatolievich, Doctor of Medical Sciences, Professor - <https://orcid.org/>

Vodolazska Oksana, Candidate of Economics - <https://orcid.org/0000-0002-7858-7118>

Volkova Nataliia Mihailivna, Doctor of Medical Sciences, Professor - <https://orcid.org/0000-0002-1775-4023>

Volodymyr Zinoviiovych Kochmarskii, Candidate of Physical and Mathematical Sciences, Professor - <https://orcid.org/0000-0003-2036-8841>

Volokh Dmitry Stepanovich, Doctor of Pharmaceutical Sciences, Professor - <https://orcid.org/>

Voropayeva Tetiana Sergiivna, Candidate of psychological Sciences, Docent - <https://orcid.org/0000-0001-8388-7169>

Vozhegova Raisa Anatolievna, Doctor of Agricultural Sciences, Professor - <https://orcid.org/>

Voznyakovska Kristina Anatoliyvna, Doctor of legal Sciences, Docent - <https://orcid.org/>

Vykhruhch Vira Olexandrivna - <https://orcid.org/0000-0003-3469-2343>

Vyshnevaska Olha Dmytrivna, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0003-1021-3176>

Vyshnevskiy Dmytro Olegovych, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0002-1270-713X>

Yakovets Tetiana Arkadiivna, Candidate of Economics, Associate Professor - <https://orcid.org/>

Yaroshchuk Inna Volodymyrivna, Candidate of Historical Sciences, Associate Professor - <https://orcid.org/0000-0001-8639-6648>

Yarova Nina Viktorivna, Candidate of Economics, Associate Professor - <https://orcid.org/0000-0002-9703-3305>

Yefimova Olha Mykolajivna, Candidate of Pedagogica Sciences, senior teacher - <https://orcid.org/0000-0001-8658-9685>

Yelnikova Mariia, Candidate of political Sciences - <https://orcid.org/0000-0001-9250-4684>

Zaiachkivska Oksana Vasulivna, Candidate of Economic Sciences, Docent - <https://orcid.org/0000-0002-8792-9204>

Zaitseva Galyna, Candidate of Chemistry, Associate Professor - <https://orcid.org/0000-0003-3138-6324>

Zakharenko Natalia, Candidate of Economic Sciences - <https://orcid.org/0000-0001-7963-1080>

Zarivna Oksana Tymofiyivna, Candidate of Pedagogica Sciences, Docent - <https://orcid.org/0000-0002-9821-4482>

Zastavetska Lesya Bogdanovna, Doctor of Geographical Sciences, Professor - <https://orcid.org/>

Zhovtonog Olga Igorevna, Doctor of Agricultural Sciences - <https://orcid.org/>

Zhuravskaya Natalia Evgenievna, Candidate of technical Sciences, Docent - <https://orcid.org/0000-0002-4657-0493>

Zhuvahina Iryna, Candidate of Economics, Docent - <https://orcid.org/0000-0002-6701-7750>

Zubkov Ruslan Sergeevich, Doctor of Economic Sciences, Docent - <https://orcid.org/>

Hurin Ruslan Serghiyovych, Candidate of Pedagogica Sciences, Docent - <https://orcid.org/0000-0003-3118-5733>

Lialiuk Natalia, Candidate of biological Sciences, associate professor - <https://orcid.org/0000-0003-4857-2449>

Babchuk Serhii, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0002-1746-5731>

Luzhetska Olha Bohdanivna, Candidate of Philology, - <https://orcid.org/0000-0002-9238-1378>

Meliantsov Petro Timofiyovych , Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0001-6598-925X>

Rublevska Nadiia Ivanivna, Doctor of Medical Sciences, Professor - <https://orcid.org/>

Ivankova Olena Volodymyrivna, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0003-1825-0262>

Chernikova Nataliia, Candidate of Historical Sciences, Associate Professor - <https://orcid.org/0000-0002-5470-0622>

Vynohradenko Serhii Oleksandrovych, Candidate of economic Sciences, Associate Professor - <https://orcid.org/0000-0002-8520-6504>

Korotenko Ghryghorij Mykhajlovych, Doctor of Technical Sciences, Associate Professor - <https://orcid.org/0000-0003-3774-5260>

Dzhulii Larysa Vasylivna, Candidate of economic Sciences, Associate Professor - <https://orcid.org/0000-0001-9475-7175>

Dzhulii Vladimir Mykolayovych, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0003-1878-4301>

Rozmaryna Albina, Candidate of economic Sciences, Associate Professor - <https://orcid.org/0000-0001-6463-3841>

Yampolska Larysa Mykolayivna, Candidate of Historical Sciences, Associate Professor - <https://orcid.org/0000-0001-7884-8050>

Gromova Olena Volodymyrivna, Candidate of economic Sciences, Associate Professor - <https://orcid.org/0000-0002-1332-8094>

Penyak Pavlo Stepanovych, Candidate of Historical Sciences, senior researcher - <https://orcid.org/0000-0002-9168-4123>

Bilorusets Lesia, Candidate of economic Sciences, - <https://orcid.org/0000-0003-4857-2035>

Ivanova (Kedyk) Veronika Petrivna, Candidate of legal Sciences, Associate Professor - <https://orcid.org/>

Fedoriv Viktor Mykhailovych, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0002-4499-0910>

Bersh Anastasiia, Candidate of legal Sciences, Associate Professor - <https://orcid.org/>

Safronov Valeriy Kostiantynovych, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0002-7300-9861>

Korzhev Yevhen Ivanovich, Candidate of geographical Sciences, senior researcher - <https://orcid.org/0000-0003-2677-5296>

Ilchenko Andrii, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0001-7927-874X>

Tarasevich Iryna Grygorivna, Candidate of technical Sciences, Associate Professor - <https://orcid.org/0000-0002-3249-619X>

Pashchenko Maya Ivanivna, Candidate of pedagogical Sciences, Associate Professor - <https://orcid.org/0000-0003-4743-6250>

Vasko Olha Oleksandrivna, Candidate of Pedagogical Sciences, Associate Professor - <https://orcid.org/0000-0001-5241-0958>

Bilier Oksana Slavivna, Candidate of Pedagogical Sciences - <https://orcid.org/0000-0001-9969-3289>

Krylik Lyudmila Viktorivna, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0001-6642-754X>

Kushnirov Pavlo Vasylovych, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0001-5894-538X>

Varnavska Larisa, Candidate of Pedagogical Sciences, Associate Professor - <https://orcid.org/0000-0001-8664-4007>

Mykhaylyuk Vitalii, Doctor of Historical Sciences, Professor - <https://orcid.org/0000-0002-8458-0617>

Adler Oksana, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0002-4673-366X>

Buryak Marina Valeriivna, Candidate of Pharmaceutical Sciences, Associate Professor - <https://orcid.org/0000-0002-6671-9662>

Sytnyk Oleksandr Ivanovich, Candidate of Political Science, Associate Professor - <https://orcid.org/0000-0001-8106-748>

Zarudna Nataliia, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0002-9868-2278>

Shvets Tetiana Anatoliivna, Candidate of Pedagogical Sciences, - <https://orcid.org/0000-0002-1234-0710>

Bespalova Alla, Doctor of Technical Sciences, Professor - <https://orcid.org/0000-0003-3713-0610>

Holubieva Iryna Volodymyrivna, Candidate of Pedagogical Sciences, - <https://orcid.org/0000-0002-8631-2835>

Oleksiuk Vitalii, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0003-4841-458X>

Bardadym Mariia, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0002-6067-9129>

Ustinova Iryna Ihorivna, Doctor of Architectural Sciences, Professor - <https://orcid.org/0000-0002-1728-0200>

Lysa Olena, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0002-1870-0481>

Yeletskykh Svitlana Yakivna, Doctor of Economic Sciences, Professor - <https://orcid.org/0000-0002-8709-0496>

Belova Victoria Volodymyrivna, Candidate of Pedagogical Sciences, - <https://orcid.org/0000-0002-5427-8943>

Yamash Yuri Volodumurovuch, Candidate of Art History, Associate Professor - <https://orcid.org/0000-0002-3259-083X>

Teleky Mariia Mykhaylivna, Candidate of Philological Sciences, Associate Professor - <https://orcid.org/0000-0003-4161-4386>

Babko Natalia, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0002-7620-9500>

Kutnyi Bohdan, Doctor of Technical Sciences, Associate Professor - <https://orcid.org/0000-0002-9016-5161>

Zalizniak Alla Mykolaivna, Candidate of Pedagogical Sciences, Associate Professor - <https://orcid.org/0000-0002-5255-385X>

Dudun Tetayna Volodymyrivna, Candidate of Geographical Sciences, Associate Professor - <https://orcid.org/0000-0002-9960-9793>

Mormul Mykola Fedorovych, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0002-8036-3236>

Oleksyn Artur, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0002-4194-5962>

Zenkin Mykola, Doctor of Technical Sciences, Professor - <https://orcid.org/0000-0002-8840-0572>

Zahorodnia Liudmyla, Candidate of Medical Sciences, Associate Professor - <https://orcid.org/0000-0003-1908-0461>

Ivchyna Nadiia, Candidate of Medical Sciences, - <https://orcid.org/0000-0001-9650-8818>

Romanchuk Lyubov Anatoliyvna, Candidate of Philological Sciences, - <https://orcid.org/0000-0001-5759-0126>

Atamas Oleksandr Petrovych, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0002-7511-8586>

Aloshyna Tetiana, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0002-2729-4454>

Fisunencko Nadiia, Candidate of Economic Sciences, - <https://orcid.org/0000-0003-3985-7813>

Tonkykh Oleksii Grygorovych, Candidate of Economic Sciences, Associate Professor - <https://orcid.org/0000-0001-7823-4761>

Tolok Galina Arsenivna, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0002-2971-1645>

Antypenko Nadiia, Doctor of Economic Sciences, Professor - <https://orcid.org/0000-0003-4132-4709>

Samoilenko Olena, Candidate of Philology, Associate Professor - <https://orcid.org/0000-0001-5040-874X>

Usenko Andrii Yuriyovych, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0001-7467-6220>

Neilenko Sergii Mykhaylovich, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0002-7282-2682>

Zarakhovskiy Oleksandr Yevhenovych, candidate of cultural studies, Associate Professor - <https://orcid.org/0000-0003-4263-7870>

Lemeshko Andriy Viktorovych, PhD in Computer Engineering, Associate Professor - <https://orcid.org/0000-0001-8003-3168>

Rudenko Nataliia Viktorovna, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0001-8582-3126>

Miakinchenko Iryna Oleksandrivna, PhD in History and Archeology, Associate Professor - <https://orcid.org/0000-0002-4937-6418>

Poluda Viktoriia Volodymyrivna, Candidate of Pedagogical Sciences, Associate Professor - <https://orcid.org/0000-0002-0748-5720>

Antonenko Artem Vasylovych, Candidate of Technical Sciences, Associate Professor - <https://orcid.org/0000-0001-9397-1209>



UDC 664.87

**FOOD ADDITIVES IN INDUSTRY****Mariana Bondar**

assistant

ORCID ID (0000-0001-8154-0612)

Department of food technologies and microbiology

Vinnytsia national agrarian university

Sonyachna str., 3. Vinnytsia, Ukraine, 21008

**Abstract.** *In the production of dairy products in the modern food industry, various food additives are used, the purpose of which is primarily to extend the shelf life of the product, to improve organoleptic and physicochemical indicators.*

*At this stage, there are already about 45 technological classes of food additives, which requires an additional level of classification. Food additives, like any chemical compound added to a food product, can have a toxic effect, so special attention is paid to food safety. All nutritional supplements are under constant supervision. When using any food supplement, it is necessary to withstand their exact dosage and conditions of introduction. When the conditions of use change and new scientific information is available, the status of the food supplement may be changed.*

**Key words:** *food additives, antioxidants, moisturizing agents, thickeners, preservatives, dyes, acidifiers (acids), acidity regulators, emulsifiers, fillers.*

**The purpose of research.**

The development of the food industry, the modern level of scientific research, the growth of food production volumes and the expansion of their assortment contribute to the dynamic development of the country's food market and determine the increasingly widespread use of food additives in food technology. In the production of dairy products in the modern food industry, various food additives are used, the purpose of which is primarily to extend the shelf life of the product, to improve organoleptic and physicochemical indicators.

The research was carried out in the problem laboratory for monitoring the quality of food products of the Department of Food Technologies and Microbiology of the Vinnytsia National Agrarian University. The work used methods of organoleptic research, food legislation "On the safety and quality of food products".

**Research results.** The modern attitude to nutrition is the result of centuries-old observations and research, which collectively created a considered scientific theory of nutrition. In recent years, mankind has paid considerable attention to the problems of the usefulness of everyday food products for health.

Food additives are a voluminous list of materials with different characteristics that are added to food products to solve certain technological tasks. With their help, food safety increases, shelf life is extended, taste, aromatic qualities, consistency, appearance, etc. are preserved and improved.

In Europe, food additives are indicated by a numerical code preceded by the letter E. It notifies that the additive, after passing a specially developed procedure for evaluating the harmfulness/harmlessness, has been approved and allowed for use in the food industry in the European Union. This designation allows you to avoid long and unclear names that do not fit on the label. The labeling system using the letter E has increased the convenience of informing the consumer many times over. As for



the numbers, they indicate that the additive is included in a specific group of substances.

All food additives are divided into substances of natural and synthetic origin. The first are made from products that can serve as a source of food. These are, in particular, agar-agar (E406) and carrageenan (E407), extracted from seaweed. It is also pectin (E440), the source of which is fruit, gelatin, which is obtained from animal raw materials present at meat processing plants (E441), etc.

Synthetic additives, in turn, belong to one of two groups:

- 1) synthesized. Chemicals are produced. by way, but is also part of natural sources. For example, ascorbic acid (E300), which is an antioxidant, sorbic acid (E200) and benzoic acid (E210) are preservative additives;
- 2) artificial Substances that do not have natural analogues, for example, the antioxidant butylhydroxyanisole (E320), food azo dyes and others.

Classification of food additives by application

The indicated chemical name. compounds scares many, due to the incompleteness of the picture regarding this product category. It has been used in the food segment for thousands of years. Of course, we are not talking about the most complex chemicals. complex materials that appeared relatively recently. They mean elementary substances familiar to everyone: table salt, or sodium chloride, acetic acid (E260), lactic acid (E270), citric acid (E330), all kinds of spices, seasonings, etc. (yes, they similarly belong to this category of products). Carmine (E120), a natural dye obtained from insects, has been used in the kitchen since ancient times. With its help, food acquires an interesting purple color.

Until the beginning of the last century, products whose characteristics were determined by naturalness were widely used. But with new discoveries in food chemistry, the majority of natural materials have been replaced by artificial ones. Various quality and taste improvers of food were put into mass production. Today, since food additives are both natural and artificial, both options are in demand.

Food additives (their classification by application) are:

- dyes (E100-E199);
- preservatives (E200-E299);
- antioxidants, or antioxidants (E300-E399);
- stabilizers that preserve the density of food (E400-E499);
- emulsifiers, leavening agents, anti-caking agents, pH regulators (E500-E599);
- flavorings and flavor enhancers (E600-E699);
- antibiotics (E700-E799);
- reserve substances (E800-E899);
- waxes, glazing agents, defoamers and foaming agents, sweeteners, gases for packaging and ingredients for improving flour culinary products (E900-E999);
- additional substances, such as biocatalysts, enzymes, modified starches, solvents (E1000-E1999) (Table 1).

Food additives are used frequently and everywhere in Ukraine. Before buying nutritional supplements in bulk, we advise you to thoroughly understand what each group of them is, why this or that item may be needed, and what the specifics of its use are.



**Table 1 - Classification of food additives according to the E index**

Index E	Hazva of the class of food supplements	Index E	Hazva of the class of food supplements	Index E	Hazva of the class of food supplements
There are 100 and more	Dyes	There are 600 and more	Flavor and aroma enhancers	There are 1100 and more	Enzymes
There are 200 and more	Preservatives	There are 700 and more	Spare indexes	There are 1200 and more	Spare indexes
There are 300 and more	Antioxidants	There are 800 and more	Spare indices	There are 1300 and more	Spare indices
There are 400 and more	Stabilizers	There are 900 and more	Anti-caking substances	There are 1400 and more	Modified starch
There are 500 and more	Emulsifiers	There are 1000 and more	Glazing agents	There are 1500 and more	Alcohols

### *Dyes*

A group of food additives, the main purpose of which is to color food products. They restore the color that was lost during technological processing, intensify it, give food products the desired color, thereby making them more attractive and tastier. They are powdery and liquid. In practice, both natural and synthetic materials are used. One of the most popular is calcium carbonate (E170).

Various vegetable (root crops, berries, fruits, leaves, flowers) and animal raw materials serve as sources of dyes of natural origin. They are obtained by physical means. impact on the specified materials. In the composition of natural additives (carotenoids, lycopene, flavonoids, carmine, sugar color, etc.) - bioactive and taste-aromatic components that positively affect the appearance of food.

Synthetic dyes are used even more often, due to their main advantages: increased concentration, brightness of color, increased stability, as well as an extended storage period. These organic substances do not occur in the natural environment, they are obtained in laboratories by various chemical methods. reactions The most common of them are sodium salts, which dissolve well in water, and therefore facilitate production processes. Among the insoluble ones, aluminum varnishes and pigments are popular.

The huge demand for artificial dyes was influenced by their low price. But here it is worth understanding that mostly a natural supplement is better than a synthetic one, because some of the latter can have a lot of negative effects that provoke a deterioration in health. These are, in particular, additives that are prohibited for use in the food industry: amaranth (E123), red 2G (E128), erythrosine (E127), aluminum (E173), green S (E142), etc.

### *Preservatives*



Designed to suppress the functioning and reproduction of microorganisms, thereby extending the shelf life of food products. They also prevent the appearance of mold, taste and aroma characteristics that are unpleasant for humans, and prevent the formation of harmful toxic compounds characteristic of the vital activity of microbes.

Preservatives have been used in the food industry for thousands of years. From the very first: salt, alcohol, vinegar, etc. Among the most popular today: ethanol, acids (ethanoic, benzoic, sorbic and sulfuric), as well as formic acid (E236), potassium sorbate (E202), sodium benzoate (E211), sodium pyrosulfite (metabisulfite) (E223), urotropin (E239), sodium nitrite (E250), sodium acetate (E262). In addition, antibiotics can be used for this purpose: nisin, biomycin, nystatin.

Nowadays, both natural and synthetic preservatives are used. The popularity of the latter is higher for obvious reasons (maximization of efficiency, reduction of production costs). But it should be taken into account that it is not allowed to introduce them into some mass-produced culinary products. These include, in particular, flour, bread, milk, fresh meat and baby food.

#### *Antioxidants*

The purpose of the additives belonging to it is easily determined by the name of this group. Antioxidants, or antioxidants, are designed to fight unwanted oxidation processes in food. They prevent fats from spoiling prematurely, becoming bitter and, accordingly, protect the products containing them from becoming bitter. In addition, they inhibit the souring of wine, beer and non-alcoholic beverages, prevent fruits, vegetables and fruit and vegetable products from darkening prematurely.

Among the antioxidants popular in the food industry: vitamin C (E300),  $\alpha$ -,  $\beta$ -,  $\gamma$ - and  $\delta$ -tocopherols (E306-E309), succinic acid (E363). They are not only not dangerous, but also useful. If we talk about synthetic substances that can harm health, then these are E310-E312 and E320-E321.

The following antioxidants are also introduced into culinary products: sodium isoascorbate (E316), sodium citrate (E331), tartaric acid (E334), orthophosphoric acid (E338). Most often, not one supplement is used, but several types at the same time in order to maximize the result of use.

#### *Thickeners*

The purpose of involvement is to preserve and improve the structure of food products. With their help, it is easy to achieve the desired consistency. The functional duties of emulsifiers include ensuring plasticity and viscosity. Thanks to them, bakery products do not go stale any longer.

Almost all thickeners, which are allowed for use, have a natural etymology. These are the agar, pectin and gelatin already mentioned above. These are also starches obtained from potato, pea and corn raw materials. This includes lecithin - an additive made from vegetable fats, which, in addition, acts as an antioxidant. Another natural emulsion former is egg white. Here it is worth mentioning such thickeners as guar gum (E412) and xanthan gum (E415).

By the way, over time, synthetic emulsifiers are used more often in the food industry. An example of such an additive with a zero level of danger can be sodium tripolyphosphate (E451), which additionally regulates acidity, fixes color, acts as an antioxidant and complexing agent.



### *Flavor enhancers*

To make the finished product as tasty as possible, special additives are added to it, which enhance the taste parameters. How do flavor enhancers work? Take at least fresh vegetables, meat, fish. They have intense taste-aromatic characteristics, due to the fact that they contain a lot of nucleoside phosphates - components that intensify the perception of taste and stimulate the termination of the corresponding receptors. During storage and processing, the volume of nucleoside phosphates declines, because of this, it is advisable to introduce them, synthesized artificially. Examples of such additives are maltol and ethyl maltol. They increase the perception of creamy, fruity and some other smells. Thanks to them, mayonnaise, yogurt, ice cream with a low calorie content seem fatter than they actually are. Potassium acesulfame (E950), sodium cyclamate (E952), saccharin (E954), glucose, fructose are used for sweetening.

Almost everyone has heard of such an additive that enhances taste characteristics, such as monosodium glutamate (E621). Today it can often be seen in sauces, stock cubes, semi-finished products, potato chips, croutons, etc. Ribotide flavor enhancer is also in great demand, the components of which are Na inosinate (E631) + Na guanylate (E627). It is widely used in chips, fast food, and seasonings.

### *Flavorings*

Additives that are added to food to improve taste and aroma properties. They are natural, identical to them, and artificial. The former contain only natural aromatics of plant origin (components of volatile materials separated during distillation, water-alcohol extracts, dry aggregates and essences). Others are isolated both from natural raw material sources and by chemical means. synthesizing They contain compounds that are characteristic of plant and animal raw materials. The third category includes additives that contain at least one artificial element, as well as possible inclusion of natural and identical aromatic substances.

Flavoring food additives can be produced in the form of powder, liquid or paste. Flavoring components, as a rule, make up to 20%. The rest falls on the carrier (solvent), which determines the form of the material (powder or liquid).

### *Allowed in Ukraine*

Every manufacturer of the specified industry should know which food additives are allowed for use in the food industry of Ukraine. And not just to know, but to use this information in practice. The Cabinet of Ministers of Ukraine, by Resolution No. 12 dated 01/04/1999, established an exhaustive list of food additives that can be used. Everything that is not on this list is prohibited to be used on the territory of our country at the legislative level. Otherwise, the violator faces punishment for illegal actions, namely a fine, the amount of which is determined by the Law of Ukraine «On the Protection of Consumer Rights» (Article 23).

There is one more document that must be followed. These are the Sanitary Rules and Regulations for the Use of Food Additives, approved by Order of the Ministry of Health No. 222 of July 23, 1996. It describes in detail the procedure for using food additives permitted by Ukrainian legislation. According to it, it is permissible to introduce new additives into food (or change the conditions of introduction) only when it is not possible to solve the task by other technological methods, with the aim



of achieving the following goals:

- preservation of natural properties and nutritional value. It is permissible to reduce the last parameter only if it is provided for by the production technology, and for special dietary food;

- extension of the shelf life, maximization of quality parameters and stability, as well as improvement of organoleptic properties. It is important to observe the following conditions: the essence of the product must not change, the consumer cannot be misled, and the health risks must not increase compared to the exposure of the previous components;

- improving processes such as preparation, processing, packaging and other production steps, plus packaging, transportation and storage. At the same time, innovations cannot be aimed at hiding the defects of raw materials or negative changes in food, which are manifested due to non-compliance with technical regulations and sanitary standards at any of the specified stages.

It is forbidden to use food additives in order to hide from the consumer the deterioration of the product, its improper use or the use of low-quality raw materials.

In addition, sanitary rules and regulations describe which additives and in what amounts can be introduced into various foods. They also provide a procedure for obtaining permission for the use of certain types of additives at food enterprises.

The use of food additives, namely the legislative side of the issue, is far from ideal. Contradiction is mass. Of course, there are substances whose safety cannot be doubted among those allowed. This is, for example, citric acid or beeswax. But there are also those (in particular, tartrazine) that can have a negative effect on health and provoke various diseases. Therefore, it is extremely important to adhere to dosages and all technological points in order to reduce any risks as much as possible.

Will the manufacturer be penalized if a food additive included in his product harms the consumer? This is a specific question that cannot be answered immediately with «yes» or «no». First, the plaintiff will need to establish a cause-and-effect relationship that the health has worsened precisely as a result of the use of the supplement, and to confirm this med. conclusion It is also necessary to provide a receipt that confirms the purchase of products.

If there are suspicions that the purchased and/or used product contains additives prohibited for use, it is also possible to review the case with further punishment of the unscrupulous manufacturer. But in this case, the prohibited additive as an ingredient of the finished product is unlikely to be indicated on the label. Then the consumer will need to conduct an examination on his own.

#### *Useful food supplements*

Many people have a very negative attitude to the phrase «food supplements», and it does not matter what substances we are talking about. E-shki is bad, period. In fact, there are not only those supplements that have certain risks for human health, but also those that are considered harmless. There are also useful nutritional supplements. Yes, yes, those that can have a positive effect on the body are also involved in cooking and are marked with codes with the letter E.

If you store food correctly, if you follow basic requirements for packaging, do not exceed the permissible amounts of additives, the latter do not cause any harm in



most cases. It is another thing if the rules of use are neglected, if incompatible ingredients are combined. In this case, even harmless additives can lead to a toxic effect.

### *Useful*

So, the list of food additives that are considered useful is small, but it is there. You need to know about these substances (and they are present in different groups) so that when you see their designation on the package, you can be completely calm. Here they are:

- ✓ curcumin (E100). Bright yellow dyes of natural origin, extracted from turmeric. Effective against inflammations, tumors, have an antioxidant effect;
- ✓ riboflavin, or vitamin B2 (E101). Improves the condition of the skin, hair, nail plates and thyroid gland, promotes the formation of antibodies, erythrocytes and regulates reproductive function. Since it cannot be accumulated in the body, products containing this additive-dye must be present in the diet. It is noteworthy that even when consuming large amounts of food with riboflavin, no toxic effect is observed;
- ✓ sodium salt of vitamin B2 (E106). Another dye used to give food a yellow color. The benefit is the same as the previous supplement;
- ✓ carotenes (E160a). Orange pigment, vital element, low-toxic antioxidant;
- ✓ lutein (E161b). Additive-dye that improves vision. It is also recommended for stroke and rheumatoid arthritis. Excellent preventive material for people who are at the computer for a long time;
- ✓ ascorbic acid/vitamin C (E300). Antioxidant food supplement. It has a positive effect on the functioning of connective and bone tissues, serves as a regenerator and coenzyme in some metabolic processes, significantly increases immunity;
- ✓ tocopherols/vitamins E (E306-E309). Antioxidants are important for the human body;
- ✓ pectins (E440). Food additive from the category of thickeners. Lowers the level of cholesterol in the blood, helps in cleansing the intestines and facilitates the removal of slag formations;
- ✓ L-leucine and 2,6-diaminohexanoic acid (E641, E642). Useful aminocarboxylic acids;
- ✓ calcium and potassium iodates (E916, E917). Among the functional possibilities is the saturation of culinary products with iodine.

### *Harmless or neutral*

The list of harmless additives is even longer when compared with the previous ones. These are all acidifiers and substances that regulate acidity, as well as some emulsifying components and positions from other functional groups. Important: although they are considered neutral in terms of impact on the human body, it is necessary to use them in food products and consume such food carefully. Remember: dosage and combination with other compounds are important.

The harmlessness of such additives is a relative concept. Adults and children react differently to them. If for adults the risks of using, say, salt, vanilla, etc., are minimal, then the children's body may react negatively. In addition, an indirect and



side effect of supplements is possible. Some of them are able to bind vitamins or valuable protein components, as a result of which they are removed from the body. If this happens on a regular basis, the child may feel the lack of certain elements. Allergic manifestations are also no exception.

Harmless additives include the following:

- dyes (chlorophyll and its copper complexes with chlorophyllin, sugar colors, coal, beet red, anthocyanins, chalk, tannins);
- preservatives (potassium sorbic acid, carbon dioxide, acetic, lemon and milk types);
- acidity regulators (hydroxybutanedioic acid, fumaric acid);
- antioxidants (synthetic alpha- and gamma-tocopherols, lecithin);
- stabilizers (agar-agar, hydrochloric acid);
- sweeteners (sorbitol);
- leavening agents (baking soda);
- other additives (wax, in particular wool wax, petrolatum, paraffin, benzoic acid, ortho-sulfobenzoic acid imide + its sodium/potassium/calcium salts, as well as sucralose).

#### *Harmful food additives*

Of course, there are also unhealthy food additives, and there are a lot of them. Most of them have permission to use, so caution should be in the first place. Substances harmful to the body carry the risk of allergies (they act differently on different people), can aggravate chronic diseases. What else are harmful food additives? Able to provoke diseases of the gastrointestinal tract, cause skin diseases, pressure disorders, have a carcinogenic effect. It is forbidden to use the most harmful food additives in the food industry. About this - a little below.

The main thing is to understand that you can minimize risks by avoiding excessive use of harmful substances. Almost each of them has a daily rate of consumption, which cannot be exceeded. After all, this is the main reason for the appearance of negative consequences.

Food additives are harmful. Here is the list:

- very dangerous (amaranth E123, ammonium chloride E510, sulfuric acid E513, ammonium hydroxide E527);

- dangerous (acid yellow E102, «sunset» E110, carmine E120, bright red 4R E124, erythrosine E127, Allura Red E129, Brown HT E155, ruby lithol BK E180, sodium salt of sorbic acid E201, sulfuric anhydride E220, sodium bisulfite E222, sodium metabisulfite E223, potassium pyrosulfite E224, potassium hydrosulfite E228, thiabendazole E233, dimethyl dicarbonate E242, alginate E400, alginates Na, K, NH<sub>4</sub><sup>+</sup>, Ca and propylene glycol E401, E402, E403, E404, E405, potassium carbonate E501, E502, ammonium carbonate E503, glutamate E620, maltol E636 and ethyl maltol E637);

- carcinogenic (Patent Blue V E131, Food Green S E142, charcoal E153, benzoic acid E210, benzoates K and Ca E212, E213, ethyl ether of para-hydroxybenzoic acid E214 and its sodium salt E215, propyl-4-hydroxybenzoate E216);



- those that lead to stomach problems (orthophosphoric acid E338, Na, K, Ca phosphates E339, E340, E341, magnesium phosphate E343, sodium pyrophosphates E450, methyl, ethyl, hydroxypropyl and methylethyl cellulose ethers E461, E462, E463, E465, KMC E466);

- those that provoke skin diseases (Brilliant Black BN E151, carotenes E160, orthohydroxydiphenyl E231, sodium orthophenylphenol E232, urotropin E239, octyl gallate E311, dodecyl gallate E312, BHA E320, poly-1-decene hydrogenated E907, L-aspartame-L-phenylalanine E951, lysozyme E1105);

- which are the cause of intestinal diseases (Chocolate Brown FK E154, guanylate E626, disodium guanylate E627, 5'-guanylates K and Ca E628, E629, inosine monophosphate E630, sodium salt of inosine E631, disubstituted potassium inosiate E632, Calcium 5'-inosinate E633, 5'-ribonucleotides Ca and Na E634, E635);

- additives that have a bad effect on pressure (Brown FK E154, sodium nitrite E250, potassium nitrate E252);

- those that pose a danger to children (lactate E270);

- prohibited (alkanet E103, yellow acidic G E105, alpha-naphthol orange E111, Citrus Red 2 E121, amaranth E123, ponso SX E125, ponso 6R E126, blue solanthrene FF E130, black 7984 E152);

- suspicious (Acid Yellow 3 E104, azorubin E122, chlorophyll copper complexes E141, titanium dioxide E171, aluminum E173, bakout resin E241, ethers of PG and fatty k-lots E477).

#### *Dangerous food additives*

Everyone decides for himself whether to use nutritional supplements that are dangerous for health or to refuse them. The manufacturer is obliged to put information about them on the packaging, in case of use in the manufacture of his products. A consumer who cares about his health should carefully study the composition before buying a particular product.

Preservatives, sugar substitutes, flavor enhancers... All this is not uncommon among the ingredients of modern food, which is present on store shelves. The most dangerous food additives are also allowed for use. Therefore, you need to know about them, and whether or not to use products with their content is everyone's business.

Another point is prohibited food additives. We listed them above. They mainly provoke malignant tumors, contribute to the appearance and development of allergies. Their manufacturers do not have the right to introduce them into food products.

There is also a list of additives that have not received official permission for use, because the mechanism of their action on humans has not been fully studied. There is enough information on such substances (which belong here and how they can be dangerous) on the Internet. Get to know her. It is important.

#### *Natural food supplements*

We have already said above that food additives can be natural and synthetic. Now we want to focus a little on the first group.

Additives of natural origin are substances that are created by nature. Their use in the food segment has been going on for thousands of years. Although, for the sake of fairness, it is worth noting that progress and current technologies have greatly



increased the list of these materials.

All natural supplements that can be eaten are divided into three groups:

1. Additives of plant origin. Produced from plants and algae. There are many such products. What can be counted here? Usually, natural dyes, flavoring additives, etc. Materials contained in plant organisms, their fruits in their pure form. Lemon juice (E330) is present in citrus fruits, carotene (E160) and lactoflavin (E101) in tomatoes, and sodium alginate (E400) in seaweed.

They can enter the body naturally - together with plant food. Their overwhelming number has a positive effect on people: it reduces the risk of a number of diseases, strengthens the immune system, etc. But some herbal supplements can lead to allergies and other ailments, especially if we are talking about entering the body in large quantities.

2. Supplements of animal origin. The raw materials of this category are living organisms and their components (various animal fats or pigment cells). Emulsifiers are made from fats, and dyes are made from pigments. An example can be cochineal (E120), which is obtained from insects that produce a persistent pigment of a bright red color. Animal supplements, as a rule, do not pose a danger to humans. But their designation on the package is of great importance, first of all, for vegetarians.

3. Additives-minerals. Substances obtained from various earth minerals. This includes, first of all, salts, metal oxides and alkalis: chalk (calcium carbonate), sodium bicarbonate (sodium hydrogen carbonate), etc. With the development of chemical science, many additives that were previously produced only from minerals began to be created synthetically. In this way, it was possible to reduce the cost of finished products, since the extraction of minerals is quite expensive.

Is it possible to use only natural materials? In some cases it is possible, in other situations - not. Modern production aspects are so different that a wide variety of additives may be needed to improve the properties of food products. And some food could not exist at all without the use of auxiliary ingredients.

If there is an opportunity to use a natural substance instead of a synthetic one, is it better to do so? Maybe. But one should not forget that natural additives (a priori perceived as safe, harmless) can sometimes be more dangerous than chemically synthesized ones. by. The key here is the dosage. If increased volumes are used, then almost any substance can be toxic. If compliance with dosages is implemented, then it can be said with almost 100% certainty that such natural, permitted food additives are not harmful.

*How do food additives affect the body?*

Everything is individual. There is no unequivocal answer to this question. Food additives, their impact on the human body, cannot be described briefly and precisely. Each person reacts differently to different supplements and their different amounts. It is clear that all supplements affect health to one degree or another. Allergic reactions, aggravation of ailments, deterioration of condition are observed somewhere. In other cases, the functioning of individual organs and systems improves, as well as the human condition in general. The pros and cons of nutritional supplements are like two sides of a coin. If we talk about health benefits, then we should, first of all, consider the useful supplements that were discussed above. Anti-inflammatory, anti-





tumor, antioxidant and other positive effects on the body of some supplements have been proven. Some of them improve the skin, hair, and nails, others have a good effect on reproduction, and others have a good effect on vision. Some improve the work of the immune system, others saturate the body with iodine, others remove waste products from it, etc.

As for the disadvantages, the entire list of food additives gives a considerable list of negative points. These are, in particular:

- allergies;
- inflammation;
- respiratory tract problems;
- increase in cholesterol level;
- hepatic colic;
- fatigue;
- headaches;
- nausea;
- numbness of fingers and toes;
- redness of the face;
- influence on the psycho-emotional state of a person;
- carcinogenic effect.

To balance the positive and negative sides, we do not get tired of repeating it, allows compliance with the rules and regulations for the use of food additives. Substances that are allowed and in the quantities specified in regulatory documents are the only correct way to use additives together with culinary products.

Another important aspect that cannot be ignored when considering food additives is storage conditions.

Additives, as well as food products of which they are a part, must be packaged and packaged in such a way that safety is achieved and the consumer properties specified by the manufacturer are ensured throughout the shelf life, subject to compliance with the necessary conditions.

Prescriptions in the storage plan concern, first of all, temperature, contact with sunlight, moisture. The best place for most supplements is a dark, dry room that is relatively cool. The container must always be tightly closed. Also, children, animals and outsiders should have limited access.

The materials used for packaging dyes and flavorings must meet the requirements of technical regulation in the area of safety of packaging that comes into contact with food. When packing dyes, it should be taken into account that most of them react with metals, in particular with aluminum and galvanized iron. Accordingly, such packaging is not suitable for them. But food plastic is what is needed.

According to the regulations, labeling must also be carried out. Correct storage conditions declared by the manufacturing company on the basis of technical documentation. requirements must also be followed during transportation.

Expiry date of dye, flavoring or other. additives depends on various factors and is specified by the manufacturer. It must be taken into account in food production.

Natural dyes do not last long. They are affected by the environment, which leads



to gradual destruction. As a rule, their storage period is no more than one year. Artificial ones, thanks to preservatives, are able to keep their properties for three years. In order for the natural dye not to spoil as long as possible, it should not be frozen, and it is impossible to exceed the storage temperature more than 16 °C. It is also important to maintain optimal humidity, it should not be high. In the case of artificial dye, it is worth taking care of the lack of contact with sunlight and also monitor the storage.

### Conclusions.

It has been established that the main types of food additives used in the dairy industry do not have a beneficial effect on the human body, but without them, unfortunately, modern production cannot compete in the food market. A complete rejection of the use of food additives would also lead to the disappearance from store shelves of a number of popular products, the production of which is impossible without the use of a mixture of preservatives (usually a combination of sodium benzoate (E211) and potassium sorbate (E202), sulfur dioxide (E220), which prevent food from spoiling. Also, they have a big role in the technology of traditional food products of the future. Therefore, when you see the letter «E» on the product label, you should treat food additives wisely.

### References

1. Solomon A.M., Vishtak I.V., Voytsytska O.M., Bondar M.M. Food supplements and their functional role. Agrarian science and food technology. 2018. Issue 4 (103). C. 147-157.
2. Lastukhin Yu.O. Nutritional supplements. E-codes. Building Obtaining. Properties. Education manual. Lviv. Center of Europe. 2009. 836 p.
3. Solomon AM, MM Bondar. Fermenting cultures in the dairy industry. Agrarian science and food technology. 2017. Issue 5 (99). P. 128-135.
4. Food supplements. Compiled by: V.S. Tymoshenko; general ed. V.L. Ivanova. Lviv. 2002. 144 p.
5. Solomon A.M., Bondar M., Dyakonova A. Development of technological sour – milk dessert enriched with bifidobacteria. EUREKA Life Sciences. 2019. No. 2. R. 20-25.
6. Law of Ukraine «On Safety and Quality of Food Products» dated September 6, 2005. Document 2809-1. Voice of Ukraine. 2005. No. 220. 69 p.
7. Vlasenko V.V., Bondar M.M., Semko T.V., Solomon A.M. Functional food products with fillers. Technology, energy, transport of agricultural industry. 2016. No. 3 (95). P. 106-109.
8. DSTU 4518:200 «Food products. Labeling for consumers. General rules» (with amendments and Amendment No. 1) Kyiv. State consumer standard of Ukraine. 2010. 41 p.
9. Vlasenko V.V., Bondar M.M., Solomon A.M., Semko T.V. Sourdough starters and their types in cheese production. Food technologies. Lviv. 2016. Vol. 18. No. 2 (68). P.157-160.



## CONTENTS

### Mechanical engineering and machinery

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-039> 3

DETERMINATION OF THE MAXIMUM NUMBER OF BRAKED ROLLER SUPPORTS OF THE CONVEYOR, AT WHICH THERE IS A RISK OF LOSING THE DRIVE TRACTION CAPACITY

*Smirnov A. M., Kiriia R. V.*

*Mishchenko T. F., Mostovyi B. I.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-041> 11

THE INFLUENCE OF ELECTRIC DISCHARGES ON THE QUALITY AND CHARACTERISTICS OF HOPS

*Zaporozhets Y. V., Burlaka T. V.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-042> 15

ANALYSIS OF THE INFLUENCE OF DIFFERENT FACTORS ON ASSESSING THE INTENSITY OF BITTERNESS OF HOPS EXTRACT

*Zaporozhets Y. V., Burlaka T. V.*

### Electrical engineering

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-043> 19

CALCULATION METHOD OF INDUCED VOLTAGE OF OVERHEAD POWER LINES

*Fedoriv M., Kurlyak P., Batsala I., Mykhailiv I.*

### Engineering instruments, meters, etc. Industrial instrumentation

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-017> 25

STABILIZER QUALITY INDICATORS

*Bezvesilna O. M., Hrynevych M. S., Tolochko T. O.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-018> 29

INCREASING THE SPEED DUE TO THE IMPROVEMENT OF THE TECHNICAL CHARACTERISTICS OF THE INSTRUMENT COMPONENT OF THE STABILIZER

*Bezvesilna O. M., Nechai S. O., Tolochko T. O.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-021> 33

ANALYTICAL REVIEW OF AUTOMATED STABILIZATION COMPLEXES

*Bezvesilna O. M., Nechai S. O., Tolochko T. O.*



<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-025> 39

EXPERIMENTAL THERMAL CONDUCTIVITY DETERMINATION  
OF LIQUIDS AND SUBSTANCES WITH A PHASE TRANSITION

*Sklyarenko E.V., Ivanov S.O., Dekusha L.V., Vorobiov L.Y.*

**Electrical engineering. Electronics. Nuclear engineering**

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-027> 49

SIMULATION OF SOLAR POWER PLANT OPERATION IN  
CONDITIONS OF PARTIAL SHADING

*Glad I.V., Batsala Y.V., Fedenko V. Y., Kiiianiuk O. I.*

**Mining engineering. Metallurgy**

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-048> 55

IMPROVING THE CORROSION RESISTANCE OF  
HOT-ROLLED STEEL PIPES

*Bohdan D.A., Balakin V.F., Balakhanova T.V.  
Kuznetsov Ye.V., Nykolayenko Yu.M.*

**Animal products. Cereals and grain. Milling industry**

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-013> 68

INNOVATIVE CRAFT BAKERY TECHNOLOGIES

*Semko T.V., Pahomska O V.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-016> 74

FOOD ADDITIVES IN INDUSTRY

*Mariana Bondar*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-033> 86

THE INFLUENCE OF MATERNAL NUTRITION ON THE  
DURATION OF INTRAUTERINE DEVELOPMENT OF CALVES

*Prylipko T.M., Koval T.V.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-037> 90

STANDARDS OF PRODUCT MARKETING TRACEABILITY  
FISHERY

*Prylipko T.M., Fedoriv V.M.*



**Industrial engineering. Management engineering**

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-004> 96

RESEARCH OF CANVAS TECHNOLOGY IN WEB-APPLICATIONS

*Terentyev O.O., Gorbatyuk Ie.V., Lototskyi A.V.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-009> 101

MATHEMATICAL MODELING OF THE LOW-TEMPERATURE SEPARATION PROCESS

*Horbiychuk M.I., Yednak I.S., Skrypka O.A.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-056> 123

DEVELOPMENT FEATURES OF MOBILE APPS IN THE CONTEXT OF USER EXPERIENCE

*Kutelmakh R.K.*

<http://www.moderntechno.de/index.php/meit/article/view/meit27-01-060> 129

THE OVERVIEW OF NEURAL RENDERING

*Zavalniuk Ye.K., Romanyuk O.N.,  
Korobeinikova T.I., Titova N.V., Romanyuk S.O.*



*International periodic scientific journal*

# MODERN ENGINEERING AND INNOVATIVE TECHNOLOGIES

Heutiges Ingenieurwesen und  
innovative Technologien

Indexed in  
INDEXCOPERNICUS  
high impact factor (ICV: 87.25)

*Issue №27  
Part 1  
June 2023*

Development of the original layout - Sergeieva&Co

Signed: June 30, 2023

Sergeieva&Co  
Lußstr. 13  
76227 Karlsruhe  
e-mail: [editor@modern techno.de](mailto:editor@modern techno.de)  
site: [www.modern techno.de](http://www.modern techno.de)

Articles published in the author's edition





**[www.moderntechno.de](http://www.moderntechno.de)**

e-mail: [editor@moderntechno.de](mailto:editor@moderntechno.de)