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Biotechnology for formation of aromatic properties of national- foodstuffs on the basis of meat raw material under influence of bacterial crops and chromato-mass-spectrometric analysis of the flavoring components

Abstract

Describes the process of the formation of the organoleptic characteristics of the raw sausage "Brunswick", prepared by the original fermented technology of the VM Gorbatov All-Russian Meat Research Institute in the presence of reactive mixtures of starter cultures *Lactobacillus plantarum/Staphylococcus carnosus*, and *Lactobacillus plantarum/Micrococcus varians*. Identified changes in the pool of chemicals that make up the flavor and aroma of the national product, associated with the presence of bacterial cultures and added cardamom and black pepper.

Keywords: meat raw materials, chromato-mass-spectrometric, *lactobacillus plantarum*, black pepper, cardamom, isoleucine

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Introduction

Aroma is the most important organoleptic characteristic of meat products. Aroma is a human response to a complex of volatile substances contained in the air zone around the product when it is consumed. The complexity of studying the fragrance consists in the fact that it is formed by a huge number of substances of different chemical nature. However, these substances are present in the product as a rule in minimal concentrations, but due to the very low threshold of sensitivity of human receptors, they are felt and have a significant effect on the organoleptic evaluation of the product as a whole.

The process of forming the aroma of raw smoked sausages has been studied by domestic and foreign scientists for decades.[1–5] Interest in this issue is caused by a number of objective reasons. Firstly, smoked sausages are a product of long-term production with high consumer value. Secondly, their manufacture is a combination of the most complicated microbiological and biochemical processes, including enzymatic, proteolytic and oxidative transformations, the final result of which is still difficult to predict even in the conditions of a well-established technological process. Thirdly, changing the perception of the safety and quality of sausages smoked under the influence of new scientific knowledge makes us seek ways to modify technological processes and study their impact on the formation of traditional consumer quality products. Currently, over 400 key compounds are established by scientific research conducted abroad, which determine their taste and aroma of traditional fermented sausages produced in different countries. Moreover, such studies were conducted not only in France, Italy, Spain, Belgium, but also in Portugal, Chile, Mongolia and other countries.[6–10] One of the most popular fermented products in Russia is the smoked sausage "Braunschweig", the key aromatic compounds of which have not yet been studied by modern chromatographic methods. In the last decade, this sausage is made in industrial enterprises using starter cultures containing staphylococci.

Staphylococci, in particular *Staphylococcus carnosus*, contribute to the formation of a specific flavor of the product by the transformation of amino acids (including branched chain amino acids-leucine, isoleucine and valine) and free fatty acids. Forming of aroma also depends on the type of sausages and the technology of their production. In the case of rapidly ripening sausages, the use of staphylococci promotes the formation of methyl branched aldehydes. In the case of slowly ripening sausages, the use of staphylococci in large quantities promotes the formation of methyl branched acids and sulfites, and at a low level of their introduction diacetyl and ethyl esters are formed. In addition, the formation of aromatic compounds is influenced by the addition of nitrite, nitrate or ascorbate, the parameters of pre-growing cultures and environmental factors.[11–15] The use of staphylococci, which produce a large number of aromatic compounds, allows improving the organoleptic qualities of sausages and speeding up the process of fermentation. Micrococci as starting microorganisms are recognized as less effective than staphylococci. However, the use of *Staphylococci* in starter cultures may be accompanied by a risk of developing enterotoxigenic strains of *Staphylococcus aureus* due to the inability to conduct effective microbiological monitoring in the presence of a technological related microflora. In this connection, taking into account the influence of the technology of making a particular sausage, the research on the comparative evaluation of the aroma of the traditional smoked sausage "Braunschweig" was of scientific and practical interest when replacing the *Staphylococcus strain* with a micrococcal strain in the starting culture.

Recently, studies of spatial formation of materials on the principle of 3D printing have been developed.[16–33] For computer manufacturing in the space of different objects, information on the component composition of the material is needed. Previous studies have made it possible to determine a limited number of constituent substances of different objects.[1–15] The capabilities of chromatography-mass spectrometry make it possible to establish an almost complete set of constituent chemical components of objects for various purposes. This information can be used for further copying. The aim of the work is a comparative study of the formation of organoleptic characteristics of raw sausage sausages using staphylococci and micrococci in the starting cultures. The objects of the study were samples of smoked sausage of the "Braunschweigskaya" type, manufactured industrially without introduction of the starting culture (control sample "B"), with the addition of a starting culture containing *Lactobacillus plantarum* + *Staphylococcus carnosus* (prototype "A"), Culture containing *Lactobacillus plantarum* + *Micrococcus varians* (prototype "B").

Control and prototypes were made from minced meat, consisting of 45% lean beef, 25% lean pork and 30% bacon. Nitrite salt was added in an amount of 3%, glucose 0.3%, cognac 0.25%, black pepper 0.1%, cardamom 0.05%, ascorbic acid 0.05% to ground weight. One strain of *Lactobacillus plantarum* and strains of *Staphylococcus carnosus* and *Micrococcus varians* were used to make sausage prototypes, which were added at the rate of 1.10^7U/g for the introduction of minced meat. Finished minced meat was stuffed into an artificial sausage "fibrouse" with a diameter of 48mm, forming loaves with a mass of 300g. All the samples were subjected to a precipitation at a temperature of +2, + 4°C for 24 hours. After settling, the loaves were placed in a climatic chamber and kept at a temperature of +24, + 25.5°C and a relative humidity of not more than 95% until the pH of the product decreases to not more than 5.2. After that, the humidity in the chamber was reduced to values no higher than 92%, and a phased smoking process, lasting 90 minutes, was started. At the same time, the temperature and humidity in the chamber were gradually reduced, bringing them for 8 days to 14°C and 74%, respectively. Then the samples of the sausage sausage were dried at a temperature of 12-14°C until the final moisture content of the product reached no higher than 32%.

Discussion

The analysis of the volatile odor constituents was carried out on a gas chromatograph 7890A with a mass-selective detector 5975°C VLMSD Agilent Technologies (USA). Extracts (1:1) were extracted with 40% aqueous ethanol and Folce extracts with chloroform-methanol followed by methylation with a solution of acetyl chloride in methanol.[11] The calculation of the content of the components (represented by the IUPAC name) with a mass content of more than 0.01% in the flavor/aroma mixture was carried out using the automatic database for searching and identifying the NIST08 MS Library data with a probability of a peak correlation of more than 65%. The composition of the smell of muscat for chemical components that affect the taste and aroma of the Braunschweig sausage can be represented (%) by chromatographic mass spectrometry: 3-cyclohexene-1-methanol, alpha, alpha-4-trimethyl acetate 1.52; alpha,alpha-4-trimethyl-3-cyclohexene-1-methanol acetate 9.15; 5-(2-propenyl)-1,3-benzodioxole 0.53; 5-(2-propenyl)-1,3-benzodioxole 5.66; 4-(trimethyl)-1H-pyrazole 0.61; 2-methyl-2,4-dimethoxybutane 3.70; 3,3,6-trimethyl-1,4-heptadien-6-ol 7.00; methyl-2,4-dimethoxybutane 5.93; 4-[1,3]dioxolan-2-yl-3,4-dimethyl-cyclohex-2-enone 0.49;dehydroacetic acid 10.32; N,N-diethyl-p-nitroaniline 0.15; d,l-trans-4-methyl-5-methoxy-1-(1-methoxy-1-isopropyl)-cyclohex-3-ene 0.03; 1,5-hexadiene, 3-chlor-propane 0.20;1,2,4a,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-naphthalene 1.48; 1,3-benzodioxole-4-methoxy-6-(2-propenyl)-pentamethylbenzoic acid 17.91; 1,2-dimethoxy-4-(2-methoxy-1-pro-penyl)benzene 11.78; bicyclo[5.1.0]octane 0,05; 8-(1-methylethylidene)-naphthalene 0.19; hexanoic acid, 4-methylpentyl-este-furan 0.04, picolinyl 9c,11t,13t-octadecatrienoate 0.07; furane-2-carboxylic acid, 5-[4-(1,1-dimethylethyl) phenoxymethyl]-1,2-benzenediol 0.48; furane-2-carboxylic acid, 5-(1,2,4-triazol-1-ylmethyl)-2-aminoresorcinol 0.40; 1,2,4a,5,8,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-naphthalene 1.31, 1,2,3-trimethoxy-5-(2-propenyl)-benzene 0.11, hexobarbital 0.35; 1,3-dithiacyclohexane 0.03; alantolactone 0.14; 3-methoxy-N-phenyl-2-propenamide 0.11; 1,2,3,4,4a,5,6,8a-octahydro-7-methyl-4-methylene-1-(1-methylethyl)-naphthalene0.28, N-(4,6,7,8-tetrahydro-3,13-dimethoxy-4-oxoheptaleno(1,2-f)(1,3) benzodioxol-6-yl)acetamide 0.75; 6,6-dimethoxy-octanoic acid, methyl ester 0.22; methyl tetradecanoate 4.31, 1-(1-chloro-2,3-dimethylcyclopropyl)-3,3-dimethyl-1-butyne 0.04, N-(2-iodo-4-methylphenyl)-2,2,3,3,3-pentafluoro-2-[5-(4-chloro-3-nitrophenyl)-propanamide 3.26 1,8-dioxa-cyclohexadecane-2,10-dion 0.12; 3-hexadecanone 0.02; 4,7,7-trimethyl-5-(tetrahydropyran-2-yloxy)-bicyclo [2.2.1]heptan-2-on 0.07; epiglobulol 0.06; 2-[(5-chloropentyl)oxy]tetrahydro-2H-pyran 0.04; 2-oxo-1-oxaspiro[4,5]decane-4-carbonitrile 0.15; p-(2-methylallyl)-phenol 0.05; linalool 0.30; o-methoxybenzonitrile 0.03; 1-methyl-3-ethyladamantane 0.04; 7-hexadecenoic acid, methyl ester 0.06; hexadecanoic acid, methyl ester 0.65; 4-(dimethoxymethyl)-cyclohexene 0.06; 4-methylene-1-(1-methylethyl)-cyclohexene 0.04; 1-dimethylamino-2-hydroxy-cyclobutene-3,4-dione 0.04; 5-aminoindazole 0.03; N-chloro-succinimide 0.02; 8,8-dimethoxy-2,6-dimethyl-2-octanol 0.08; 2-ethyltetrahydro-thiophene 0.03; 2-[2-[2-(2-methoxyethoxy)ethoxy]ethoxy]ethyl acetate 0.04; phenylacetic acid, 2-adamantyl ester 0.02; 5-butyl-2-pyridinecarboxylic acid 0.02; 1,2,15,16-diepoxyhexadecane 0.02; 9-octadecenoic acid (Z)-, methyl ester 0.90; octadecanoic acid, methyl ester 0.29; hexadecanamide 0.03; acetic acid, 2,4-diacetoxy-3-methyl-1-(trityloxymethyl)pentyl ester 0.05; Z-2-octadecen-1-ol 0.06; 9-octadecenal 0.03; 4-oxo-6-(1-piperidyl)-hexanoic acid 0.47; 7-nonenamide 0.03; hexadecanoic acid, 2-hydroxy-, methyl ester 0.06; 9-octadecenal 0.76; 2-heptadecanol 0.25; 7,11-hexadecadienal 0.05; tridecyl-oxirane 0.03; 18-pentatriacontanone 0.12; 2,13-octadecadien-1-ol 0.03; octadecanal 0.51; 1-methyl-cyclopentanol 0.14.

The chemical composition of the components of the smell of the second spice - black pepper, which is used in the recipe of the sausage Braunschweigskaya can be written down (%):9-octadecene 0.01; 3-undecen-1-yne 0.01; (+)-4-carene 2.64; 1,2,6,6-tetramethyl-1,3-cyclohexadiene 0.01; 1-methyl-4-(1-methylethylidene)-cyclohexene 0.02; alpha-phellandrene 0.05; 1S-alpha-pinene 0.03; 1-methyl-4-(1-methylethyl)-benzene 0.68; limonene 0.27; tetrahydro-2,2-dimethyl-5-(1-methyl-1-propenyl)-furan 0.01; 4-ethenyl-1,5,5-trimethyl-cyclopentene 0.01; 3-carene 1.47; alpha-fenchyl-methylether 0.29; 1-methyl-4-(1-methylethylidene)-cyclohexene 1.72; 2-methylisoborneol 0.06; 3,7,7-trimethyl-bicyclo[4.1.0] hept-2-ene 0.65; 2,7-dimethyl-1,3,7-octatriene 0.24; 1-methyl-4-(1-methylethyl)-3-cyclohexen-1-ol 0.03; 2,6-dimethyl-2,4,6-octatriene 0.09; camphene 0.03; ocimene 0.55; N-methyl-N-hexadecyl-ethylamine 1.23; 1,1-dimethyl-2-(3-methyl-1,3-butadienyl)-cyclopropane 0.03; biperiden 0.02; N-methyl-1H-purin-6-amine 0.19; 3-methoxy-3-methyl-1-pentene 0.08; 2-(6-heptynyl)-1,3-dioxolane 0.05; alpha,alpha-4-trimethyl-3-cyclohexene-1-methanol acetate 1.01; 1-methyl-4-(1-methylethylidene)-cyclohexanol 0.84; 2-methylene-5-(1-methylethyl)-cyclohexanone 0.18; 3,5-bis-1-dimethylethyl)-4-hydroxy-2,4-cyclohexadien-1-one 0.04; octahydro-spiro[1,3-dioxolane-2,1'(4'H)-naphthalen]-4'-one 0.02; caryophyllene 0.06; 2-undecanone 0.01; 7-amino-3-ethyl-4(3H)-

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quinazolinone 0.07; 4-aminoresorcinol 0.07; 2,3-dimethyl-3-buten-2-ol 0.05; 1-methyl-4-(1-methylethyl)-1,3-cyclohexadiene 0.57; 7-methoxy-3,7-dimethyl-octanal 1.16; d,l-trans-4-methyl-5-methoxy-1-(1-methoxy-1-isopropyl) cyclohex-3-ene 0.68; 1-chloro-3-iodo-cycloheptane 0.28; tricyclo[7.2.0.0(3,8)] undec-4-ene 3.34; 4-dimethylaminopyridin-2-amine 0.42; 1,2,3,4,4a,5,6,8a-octahydro-7-methyl-4-methylene-1-(1-methylethyl)-naphthalene 2.10; 1S,2S,5R-1,4,4-trimethyl-tricyclo[6.3.1.0(2,5)]dodec-8(9)-ene 0.05; 1,2,4,8-tetramethylbicyclo[6.3.0]undeca-2,4-diene 0.36; 6-ethenyl-6-methyl-1-(1-methylethyl)-3-(1-methylethylidene)-cyclohexene 0.18; 1,2,3,6,7,7a-hexa-hydro-2,2,4,7a-tetramethyl-1,3a-ethano-3aH-indene 1.39; 1,2,3,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-naphthalene 0.14; 1-ethyl-1-phenyl-hydrazine 0.65; 1,2,4a,5,8,8a-hexahydro-4,7-di-methyl-1-(1-methylethyl)-naphthalene 2.11; 3,5-dimethyl-benzenemethanol 0.10; 1,2,3,5,6,8a-hexa-hydro-4,7-dimethyl-1-(1-methylethyl)-naphthalene 0.85; copaene 0.08; alpha-calacorene 0.10; 2,6,10-trimethyl-3-oxo-12-(tetrahydropyran-2-yloxy)-dodeca-6,10-dien 0.12; decahydro-4a-methyl-1-methylene-7-(1-methylethenyl)-naphthalene 0.33; cholestan-22(26)-isoepoxy-3-beta-ol 1.60; 6,6-di-methyl-10-methylene-1-oxa-spiro[4.5]decane 0.56; 4-Aminoresorcinol 9.20; 2,4,6-pyrimidinetriamine 5.90; 1,2,4a,5,8,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-naphthalene 2.61; 6-ethyl-2-phenyl-indolizine 2.82; N-(4-methoxyphenyl)-2,2-dimethyl-propanamide 0.83; 2,3,4,7,8,8a-hexahydro-3,6,8,8-tetramethyl-1H-3a,7-methanoazulene 0.97; guaia-3,9-diene 0.50; 1,2,3,4,4a,7-hexahydro-1,6-dimethyl-4-(1-methylethyl)-naphthalene 0.50; 1,5,5-trimethyl-6-methylene-cyclo-hexene 0.15; himachala-2,4-diene 0.38; 3,7,7-trimethyl-bicyclo[4.1.0]hept-3-ene 1.03; 1-(1-chloro-2,3-dimethylcyclopropyl)-3,3-dimethyl-1-butyne 3.06; 4-(1,2-dimethyl-cyclopent-2-enyl)-butan-2-one 0.37; decahydro-1,1,7-trimethyl-4-methylene-1H-cycloprop[e]azulene 0.21; 1,1a,5,6,7,8-hexahydro-4a,8,8-trimethyl-cyclopropa[d]naphthalen-2(4aH)-one 0.16; 1-ethyl-cyclohexanol 0.38; 11-methylene-2,4-dimethyl-3-azatricyclo[5.3.1.0(4,9)]undec-2-ene 0.48; decahydro-1,1,7-trimethyl-4-methylene-1H-cycloprop[e]azulene 1.05; 3,3-dimethyl-2-(3-methyl-1-butenyl)-cyclohexanemethanol 0.20; 1S,2S,5R-1,4,4-trimethyltricyclo[6.3.1.0(2,5)] dodec-8(9)-ene 0.36; 7-hexadecenoic acid, methyl ester 0.15; hexadecanoic acid, methyl ester 1.15; 2,3-epoxy-geranyl acetate 0.01; 5-methyl-nonane 0.15; undec-2-enyl ester valeric acid 0.04; 6,6-dimethoxy-octanoic acid, methyl ester 0.04; 2-[[(5-alpha,17-beta)-androstan-17-yl]oxy]tetrahydro-2H-pyran 0.07; 1,13-tetradecadiene 0.03; 9-octadecenoic acid (Z)-, methyl ester 2.35; octadecanoic acid, methyl ester 0.47; octadecanedioic acid 0.04; palmitic acid vinyl ester 0.42; 7,11-hexadecadienal 0.38; 2-dodecylcyclobutanone 5.65; 9-Octadecenamide, (Z)- 0.05; 5-amino-1H-tetrazole-1-ethanol 0.07; 9-octadecenal, (Z)- 9.14; 3-methoxymethoxy-2,3-dimethylundec-1-ene 4.45; methyl-10-trans,12-cis-octadecadienoate 0.16; decanoic acid, cyclohexyl ester 3.68; 2-nonyl-cyclopropaneundecanal 2.26; decyl sulfide 0.45; 1-hexadecyne 4.79; 2-methyl-hexadecanal 1.60; 4-methyl-heptadecane 0.24.

One would expect that the substances of these spices will constitute the main bouquet of the taste of sausages. However, as can be seen from Table 1, the initial stuffing and cooking from it by accelerated fermentation of the sausage with introduced crops have an original composition of the basic substances that determine exactly the aroma of the sausage "Braunschweig". From the list of substances presented in Table 1 it can be seen that some substances or their derivatives characteristic for the organoleptic components of muscat and black pepper used in the recipe of the Braunschweigskaya sausages are present in the final product, however, the pool of substances that is ultimately formed under the action of starter cultures and technological operations eventually turns out to be practically Unique. It is known that many organic substances have a characteristic flavor, for example, indolizin-cucumber, 2-nonenal-watermelon, tetradecanoic acid-balsam, incense, 1-octen-3-ol-mushrooms, n-decane and guaiacol-tobacco, indole-fruits Pendadecanal - burnt wood, etc.[12]

Table 1 Composition of flavoring components in fat-free samples, μg/kg

1A
Cyclopentyl ester 2.82; 10-pentadecen-5-yn-1-ol 0.85; 6-tetra-O-methyl-octanoic acid; ethyl ester 0.89; trenbolone 0.93; 2-ethylacridine 2.31; eicosane 2.14; pyridine 2.26; 10-methylnonadecane 4.01; 5,6-dimethyl-phenanthridinium 2.22; 1-methyl-4-(1-methylethyl)-1,3-cyclohexadiene 0.94; 1-undecene 1.71; 1-phenyl-4-(2-cyano-2-phenylethenyl)benzene 0.54; heneicosane 3.62; 3,5-bis(1,1-dimethylethyl) 0.93; tetratriacontane 2.47; 2-hexen-1-ol 0.31; 7-methoxy-3,7-dimethyl-octanal 0.56; triacontane 3.37; (3s)-pentanol 1.02; 1-pentadecene 0.33; 1-dodecene 0.67; 4-methyl-2-hexanone 0.34; tetratriacontane 2.61 docosane 1.13; ethyl ester decanoic acid 3.86; n-nonadecanol-1 7.53; 3-methyl-tridecane 0.94; 5-ethyl-2-methyl-octane 7.13; octadecane 2.16; 2-naphthyl-p-tolyl sulfone 0.40; N-(2'-acetyl-4',5'-dimethoxyphenyl)-4-methoxy-benzamide 0.21; trans-2,3-methylenedioxy-b-methyl-b-nitrostyrene 0.29; (3,4-dimethoxy-benzyl)-(4-morpholin-4-yl-phenyl)-amine 0.46; N-(2-chloroethoxycarbonyl)-l-methionine, propyl ester 0.45; nexahydro-2H-pyrido(1,2-a)pyrazin-3(4H)-one 0.69; d-gluco-d-gulo-heptose, diethyl mercaptal 0.27; 1-(2-hydroxy-5-methylphenyl)-1-octanone (E)-oxime 0.14; 2,3-dihydro-2,8-dimethyl-benz[b]-1,4-oxazepine-4(5H)-thione 0.55; 5-(4-ethoxyphenyl)-3-(4-pyrrol-1-ylphenyl)-[1,2,4]oxadiazole 0.41; 2-methylaminomethyl-1,3-dioxolane 0.36; 1-acetyl-4-[1-piperidyl]-2-butynone 0.35; ethanethioic acid 0.21; S-[8-(diethylphosphono) octyl] ester 0.11; paroxetine 0.41; 2,4,6-trichloro-5-nitro-pyridine-3-carboxamide 0.15; 1,2,3,6-tetrahydro-1-methyl-4-[4-chlorophenyl]-pyridine 0.08; 8,8'-dimethyl-2,2'-binaphthalene-1,1',4,4'-tetrone 0.47; 2-penta-2,4-dienyl-cyclohexanecarboxylic acid, methyl ester 0.33; 1-(4-pyridinyl)-ethanone, oxime 0.26; N,N-dimethyl-phosphoramidocyanidic acid, methyl ester 0.47; 2,5-diphenyl-oxazole 0.56; 2-amino-1-piperidin-1-yl-propan-1-one 0.26; N-benzyl-N-ethyl-p-isopropylbenzamide 0.72; 6-chloro-1-nitro-naphthalene 0.45; 8-(3-ethoxypropylamino)-1,3-dimethyl-3,9-dihydro-purine-2,6-dione 0.29; 2,2,5-trimethyl-6-trimethylsilylmethylenecyclohex-4-ene-1,3-dione 0.25; 6,7-dimethoxy-3-[2-(2-methoxyphenyl)-2-oxoethyl]-1(3H)-isobenzofuranone 0.18; 2-[(N,N-dimethylamino)methyl]-3,5-dimethyl-phenol 0.26; 3-(3,6-dimethylocta-2,7-dienyl)-1H-indole 0.12; 2-acetyl-3-methoxy-benzeneacetic acid 0.71; chlorthiophos 0.31; 3-methylbenzothiophene 0.26; 3-amino-7-nitro-1,2,4-benzotriazine-1-oxide 0.10; N-(cyclohexylcarbonyl)-sarcosine, nonyl ester 0.27; 1-(3-methoxy-phenyl)-5-(5-methyl-furan-2-ylmethylene)-2-thioxo-dihyd 0.37; 6-nitro-2-p-tolyl-2H-indazole 0.24; 2-fluoro-acetamide 0.28; (3,5-dimethyl-piperidin-1-yl)-(2-iodo-phenyl)-methanone 0.27; 5H-thiazolo[2,3-a] pyridine-8-carboxamide 0.15; 3-(1-adamanthyl)-7-methyl 0.26; 2,5-dimethylbenzoxazole 0.25; 2-chloro-4-quinolinecarboxylic acid 0.28; N1-phenethyl-2-(1,3-benzodioxol-5-ylmethylidene)hydrazine-1-carbothioamide 0.62; 4-butyloxy-2-hydroxybenzamidine 0.57; 4,6-bis(diethylamino)-1,3,5-triazine-2-carbonylhydrazide 0.33; 2-ethylacridine 0.24; N-methyl-1,3-propanediamine 0.18; octahydro-2-(4-methoxyphenyl)-2H-1,3-benzoxazine 0.16; 4-[5-(diethylaminosulfonyl)-2-(2-furyl)-1-benzimidazolyl]butyric acid 0.06; 6,7-dimethoxy-3-[2-(2-methoxyphenyl)-2-oxoethyl]-1(3H)-isobenzofuranone 0.17; 2-(5-bromopentyl)-2-(phenylmethyl)-1,3-dithiane 0.01; 9-[3-(dimethylamino)propyl]-9-Borabicyclo[3.3.1]nonane 0.38; 2,6-pyridine diamidoxime 0.46; 5-(4-methyl-1,3-dioxolan-2-yl)-1,3-benzodioxole 0.27; 2-(acetoxymethyl)-3-methoxycarbonyl)biphenylene 0.24; 2-(acetoxymethyl)-3-(methoxycarbonyl)biphenylene 0.42; 2-(methylamino)-ethanol 0.16; 2-amino-acetamide 0.23; 4-bromo-3-chloroaniline 0.25; 1-[2-[4-(1-methylethyl)phenyl]-4-nitro-1,3-dioxan-5-yl]-methanol 0.31; 3-ethoxy-4-methoxyphenylacetonitrile 0.03; acetamide 0.16; chlorthiophos 0.15; 9,10-(1,2-benzeno)anthracene, 2,3-dimethyl-9,10-dihydro-1H-indole-2,3-dione 0.25;ethanone 0.22; 4H-1-benzopyran-4-one 0.23; 4-acetyl-5-(2-fluorophenyl)-1,5-dihydro-3-hydroxy-1-methyl-2H-pyrrol-2-one 0.51; 2-propoxy-ethanamine 0.19; 3-phenyl-2H-chromene 0.20; tocainide 0.15; 3-[(4-nitrophenyl) methyl]-1,2,3-benzotriazin-4(3H)-one 0.20; acridine-9-carbaldehyde 0.42; 1H,4H-benz[d]-1,3-thiazin-2-one 0.23; (9-oxo-9,10-dihydroacridin-4-yl)acetic acid 0.10; 2-(methylamino)-ethanol 0.15; 6-methyl-2-phenyl-1H-indole 0.81; 1-anthracenyl-2-pyridyl ketone 0.38; 4-phenyl-3,4-dihydroisoquinoline 0.27; trans-4'-(methylthio) chalcone 0.21; N-isopropyl-3-phenylpropanamide 0.13; 4-methyl-2--(4-isopropylbenzylidenamino)-phenol 0.11; 2-ethyl-acridone 0.09; 1,3,4,5,6-pentamethyl-2(1H)-pyridinone 0.12; 2,3-dibromo-2,3-dimethylbutane 0.35; 2-chloro-4-trifluoromethyl-benzamide 0.04; N-(aminocarbonyl)-2-ethyl-2-butenamide 0.27; N,N,N'-triethyl-1,4-benzenediamine 0.27; 4-bromo-2-chloro-benzenamine 0.27; 9-amino-1,8-dimethyl-3,6-diazahomoadamantane 0.11; methyl 3-(1-pyrrolo)thiophene-2-carboxylate 0.20; 2,5-dimethoxycinnamic acid 0.11; 1,2,5a,6,7,8-hexahydro-6,6-dimethyl-cyclopenta[c]pentalen-3(3aH)-one 0.12; 2-(3-methylphenyl)-1-phenyl-1-propene 0.15.

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Table Continued..

IB

4-ethylbenzamide 4.36; alpha-[2-(dimethylamino)propyl]-alpha-phenyl-benzeneacetonitrile 1.37; 4-ethylbenzoic acid, 2-methylbutyl ester 4.20; methoxy-phenyl-oxime 3.31; 4-morpholin-4-yl-benzaldehyde 2.41; 2-amino-4-methyl-1-pentanol 0.41; dimethylaminomethyl-isopropyl-sulfide 3.26; ornithine 16.33; 3-methyl-phenol 6.69; 1,2-dimethyl-piperidine 2.04; 1,4-octadiene 3.16; 8-azaguanine 0.97; 2,5-dimethoxy-benzaldehyde 2.30; N-methyl-p-acetophenetidide 1.64; dimethyl-phosphoramidous difluoride 4.93; 2-methyl-bicyclo[2.2.2]octan-1-ol 1.00; 3-amino-2-cyclohexenone 3.02; 2-nonadecanone 0.90; hexadecanoic acid, methyl ester 2.16; hexadecanoic acid, ethyl ester 5.85; 2-heptadecanone 1.20; methyl-16-methyl-heptadecanoate 11.25; E-1,9-hexadecadiene 1.88; 9-octadecenamide 3.86; hex-4-ynoic acid, methyl ester 0.52; N,N-di-2-propynyl-2-propyn-1-amine 0.21; 3-hydroxy-5-phenyl-1,3-dihydro-benzo[e][1,4]diazepin-2-one 0.38; 3,3,3-trifluoropropanoate 0.45; N-(2'-acetyl-4',5'-dimethoxyphenyl)-4-methoxy-benzamide 0.26; N-(4-chlorophenyl)-carbamic acid, 4-nitrophenyl ester 0.17; 2,4-hexadienedioic acid 0.16; ethyl tribromopyruvate 0.15; 1,5-dibromoadamantane-2,6-dione bis(ethylene ketal) 0.23; 4,4a,5,6,7,8-hexahydro-4,4a-dimethyl-6-(1-methylethenyl)-2(3H)-naphthalenone 0.17; 1,1,3,3-tetraallyl-1,3-disilacyclobutane 0.48; 4-(dimethylamino)-ethoxy-3-buten-2-one 0.48; (2-pent-2-enylcyclopentylideneaminooxy)acetic acid, methyl ester 0.26; 2-amino-5-methyl-[1,2,4]triazolo[1,5-a]pyrimidin-7-ol 0.14; 2-methoxy-1-(phenylmethoxy)-4-(1-propenyl)-benzene 0.21; 2-methyl-furan 0.17; 3-nonynoic acid 0.22; 3,5-cyclohexadiene-1,2-dione 0.19; 2-phenoxyphenylacetonitrile 0.22; 4-carboxy-N,N,N-trimethyl-benzenaminium 0.12; 1,1,3,3,5,5,7,7,9,9-decamethyl-carbonic acid 0.18; 5-(2-nitro-1-propenyl)-1,3-benzodioxole 0.17; o-anisaldehyde 0.11; nonadecylamine 0.26; 2,4-dioxo-3-pyrrolidinecarboxylic acid, methyl ester 0.40; 2,4-di-tert-butylthiophenol 0.38; ethylphenylmalonic acid diethyl ester 0.23; 9-hydroxy-2-methyl-8-nitro-pyrido[1,2-a]pyrimidin-4(5H)-one 0.15; 1,8-diamino-3,6-dioxaoctane 0.08; 2-acetylamino-3-(4-ethoxy-phenyl)-acrylic acid 0.30; (methylenedi-4,1-phenylene)bis-carbamic acid, diethyl ester 0.07; fumaric acid, 3-pentyl undecyl ester 0.08; 5-acetamido-4,7-dioxo-4,7-dihydro enzofurazan 0.08; 3-hydroxy-5,7-dimethoxy-2-(4-methoxyphenyl)-4H-1-benzopyran-4-one 0.20; N-(2-ethylphenyl)-carbonic acid, monoamide, propyl ester 0.22; 4-bromo-2-chloro-benzenamine 0.18; 2-furanmethanol 0.06; 1,1-cyclopropanedicarboxamide 0.24; t-butyl cyclopentaneperoxycarboxylate 0.08; 6-amino-4-hydrazino-1H-pyrazolo[3,4-d]pyrimidine 0.09; 2-chloro-4-trifluoromethyl-benzamide 0.14; N,N'-diethyl-urea 0.19; 2-hexyne 0.27; bifenox 0.09; 4-Bromo-3-chloroaniline 0.05; 2-isopropylbenzaldehyde 0.23; acryl glycine 0.11; 2-[4-(1-oxo-3-phenyl-2-propenyl)phenyloxy]-acetamide 0.27; 1-methyl-2-propenyl-3-ol benzene 0.14; 2-methyl-1-nitro-9,10-anthracenedione 0.04; 4-(dichloromethyl)-5-chloro-2H)-furanone 0.11; ethyl tribromopyruvate 0.16; 2-ethylacridine 0.26; nonadecylamine 0.16; N-(diphenylethenylidene)-methanamine 0.14; p-(9-acridinylamino)phenyl-acetic acid 0.19; 4,6-bis(1,1-dimethylethyl)-3-nitro-3,5-cyclohexadiene-1,2-dione 0.35; l-arabinose, di(thiononyl-) acetal 0.19; 3,4-diethoxy-beta-methyl-beta-nitrostyrene 0.12; 2-nitro-4-(trifluoromethyl)phenol 0.19; trans-3-ethoxy-b-methyl-b-nitrostyrene 0.15; tert-butyl 2-aminophenylcarbamate 0.16; 3-nitrophthalhydrazide 0.25; 1-octadecanamine 0.17; tetrahydro-6a-methylimidazo[4,5-d]imidazole-2,5(1H,3H)-dione 0.08; 9-(4-butyl-benzyl)-acridine 0.17; trans-2,3-methylenedioxy-b-methyl-b-nitrostyrene 0.20; 2-(benzthiazol-2-yl)-6-methoxybenzofuran 0.09; 2-mercapto-benzothiazole-6-carboxylic acid 0.11; bifemelane 0.10; 2-acetylamino-3-(4-ethoxy-phenyl)-acrylic acid 0.06; 2-methylene-butanediamide 0.15; hexamethylphosphoramide 0.06; 4-fluoro-3-nitrobenzotrifluoride 0.08; (ethenylthio)-benzene 0.13; N-(6-acetylaminobenzothiazol-2-yl)-2-(adamantan-1-yl)-acetamide 0.20; 1-benzo[1,3]dioxol-5-ylmethyl-6,7-dimethoxy-2-nitroso-1,2,3,4-tetrahydroisoquinolin-4-ol 0.03; sucrose 0.22; N-(2-ethylphenyl)-carbonic acid, monoamide 0.07; 1-heptadecanamine 0.08; phenylimine 0.25; 4-(1-methylethyl)-benzaldehyde 0.05; 3-nitrophthalhydrazide 0.13; 2-tert-butylaminomethylene-5,5-dimethyl-1,3-cyclohexanedione 0.31; 3,3-diphenyl-acrylophenone 0.24; 2-propyl-2-heptenal 0.48; 3-phenyl-2-propenoic acid 0.18; 4-acetyl-benzoic acid 0.36; styracitol 0.22.

IC

4-ethylbenzamide 3.89; methoxy-phenyl-oxime 1.79; D,L-valine 0.59; 4-(1,1-dimethylethyl)-benzenemethanol 1.50; 4-ethylbenzoic acid, undecyl ester 4.10; 2-methyl-2-propenoic acid 0.82; 2-ethylacridine 2.46; 2-methyl-2-pentenal 2.31; ornithine 5.37; bicyclo[4.1.0]heptan-3-ol 2.92; 2-methyl-cyclopentanone 1.52; 3-methyl-phenol 3.95; 2,3,5-trimethyl-1,4-benzenediol 0.89; 11,11-dimethyl-bicyclo[8.2.0]dodecane 1.37; 4-(2-aminophenylthio)-5-methyltetrahydrofuran-2-one 4.15; 3-methoxy-2,4,6-trimethyl-benzenamine 0.42; 8-azahypoxanthine 1.94; 6-methyl-2-propyl-4(1H)-pyrimidinone 0.58; triacontane 1.58; 11-(1-ethylpropyl)-heneicosane 4.01; tetradecanoic acid, ethyl ester 2.92; azacyclotridecan-2-one 0.54; 2-nonadecanone 1.36; 14-methyl-pentadecanoic acid, methyl ester 2.71; hexadecanoic acid, ethyl ester 7.08; 1-acetoxynonadecane 2.58; 2-nonadecanone 1.44; octadecanoic acid, methyl ester 1.07; trans-13-octadecenoic acid 5.88; octanamide 3.98; 2,3-2H-4-methyl-imidazole-2-one 0.92; 9-octadecenamide 1.50; 4-[p-chlorobenzyl]-1-methylpiperidine 0.67; 2-[4-(2-hydroxyethylamino)-2-quinazolinyl]-phenol 0.33; 4-iodo-N-(4-pyridinylmethyl)-1H-pyrazole-1-acetamide 0.39; 3-[1-[4-[1-(2-cyanoethoxy)cyclohexyl]buta-1,3-diynyl]cyclohexyloxy]-propionitrile 0.17; 3-(4-methylphenyl)-1-phenyl-2-propen-1-one 0.36; 2-nitrobenzyl bromide 0.13; 3-(2-methoxy-5-methylphenyl)propionic acid 0.12; 1-(3,4-methylenedioxyphenyl)-2-propanone-2-oxime 0.22; acridine-9-carbaldehyde 0.22; propanamide 0.13; 3-heptyn-1-ol 0.11; 2-amino-4-hydroxy-6,7-dibenzylpteridine 0.55; 1,2-bis(1-methyl-3,6-diazahomoadamantantylidene-9)hydrazine 0.24; 6,8,9-trichloro-1,4-dioxa-spiro[4.4]non-8-en-7-ol 0.15; 3,5-dibromo-4-pyridinol 0.10; 4-(4-methyl-1-piperidyl)-5-spiro-cyclohexane-furan-2(5H)-one 0.25; 6-methoxy-N-(4-methylbenzylideno)-benzothiazol-2-amine 0.40; N-(3-chlorophenyl)maleimide 0.27; 2-(adamantan-1-yl)-N-adamantan-1-ylethyl)-acetamide 0.23; alpha-methylene-benzeneacetic acid 0.26; 1-methylcholanthrene 0.15; (Z)-2-methoxymethoxy-4'-methyl-stilbene 0.33; paroxetine 0.09; diethyl[1-ethyl-2-(trimethylstannyl)-1-propenyl]-borane 0.23; 4-(2-hydroxyethylamino)-1-oxo-2-phenyl-1,2-dihydro-phthalazine 0.21; 3,6-dimethoxy-9-(2-phenylethynyl)-fluoren-9-ol 0.27; N-[2-(acetyloxy)-2-[4-(acetyloxy)-3-methoxyphenyl]ethyl]-acetamide 0.15; N-(aminocarbonyl)-2-ethyl-2-butenamide 0.25; 4-iodo-N-(phenylmethyl)-1H-pyrazole-1-acetamide 0.33; 2-methyl-6-(5-methyl-2-thiazolin-2-ylamino)pyridine; 2-chloro-4-trifluoromethyl-benzamide 0.58; n-hexadecylsuccinic anhydride 0.07; 2,3-dihydroxy-6-nitroquinoxaline 0.20; 4-dehydroxy-N-(4,5-methylenedioxy-2-nitrobenzylidene)tyramine 0.06; carbamic acid, methyl ester 0.39; 4-butyloxy-2-hydroxybenzamidine 0.10; 1,2-bis(trimethylsilyl) benzene 0.20; 1-octadecanamine 0.50; 6,7-dimethoxy-3-[2-(2-methoxyphenyl)-2-oxoethyl]-1(3H)-isobenzofuranone 0.11; 3-amino-2-phenazinol 0.04; 5-[(acetyloxy) methyl]-3a,4,6a,7,9,10,10a,10b-octahydro-3a,10a-dihydroxy-2,10-dimethyl-benz[e]azulene-3,8-dione 0.09; 3-alpha,12-beta-dihydroxy-bisnor-5,7-cholenic acid 0.06; bromo-benzene 0.09; N-methyl-anthranilic acid, butyl ester 0.10; dodecahydropyrido[1,2-b]isoquinolin-6-one 0.26; chlorthiophos 0.13; 2-(3,3-dimethyl-but-1-ynyl)-1,1-dimethyl-3-methylene-cyclopropane 0.16; 9-[3-(dimethylamino)propyl]-9-borabicyclo[3.3.1]nonane 0.28; 4-phenyl-pyrido[2,3-d]pyrimidine 0.31; 2-amino-1-piperidin-1-yl-propan-1-one 0.07; 3-(dimethylamino)-1-(2-furyl)prop-2-en-1-one 0.30; 1-ethynylcyclopentanol 0.13; 5-(1H-benzoimidazol-2-ylmethylene)-1,3-diethyl-2-thioxo-dihydropyrimidine-4,6-dione 0.11; 4-(3-hydroxy-2,6,6-trimethylcyclohex-1-enyl)pent-3-en-2-one 0.13; 4-acetyl-1-(2-furfuryl)-3-hydroxy-5-(4-nitrophenyl)-pyrrol-2(5H)-one 0.11; guaifenesin di-tms derivative 0.20; 1-[1-(2-fluorenyl)ethylidene]semicarbazide 0.11; (1-ethoxyethenyl)-benzene 0.12; 4-phenyl-pyrido[2,3-d] pyrimidine 0.26; 2,2'-bipyridine 0.03; methylene-propanedinitrile 0.15; nonadecylamine 0.31; 2-ethyl-4,5-diphenyl-oxazole 0.24; cis-2,3,4-trimethoxy-beta-methyl-beta-nitrostyrene 0.14; 4-allyl-3-(3-furyl)-1H-1,2,4-triazole-5(4H)-thione 0.24; 3,5-dibromo-4-pyridinol 0.40; N-methyl-1-adamantaneacetamide 0.17; 2-amino-4-hydroxy-6,7-dibenzylpteridine 0.05; 6,7,8,9-tetrahydro-3-(2-pyridyl)-pirimido[4,5-b]benzothiophen-1(2H)-one 0.05; 4-phenyl-3,4-dihydro-soquinoline 0.11; 2-methyl-5-(4-morpholinyl)-cyclohexa-2,5-diene-1,4-dione 0.15; 2-tert-butylamino-6-chloro-4-cyclohexylamino-1,3,5-triazine 0.05; 5-acetamido-4,7-dioxo-4,7-dihydrobenzofurazan 0.11; 2,4,6-trifluoronitrobenzene 0.13; 1-piperonyl-3-sulfamoyl-1,2,4-triazole 0.22; 2-amino-3-cyano-5-aldoximinopyrazine-1-oxide 0.08; 3-chloro-2,3-dihydroximino-propanenitrile 0.11; 2,4'-bipyridine 0.15; atomoxetine 0.10; 1,1,2,2,3,3-hexamethyltrigermane 0.04; 4-methoxymethylbenzamide 0.04; 2-allylaminomethylene-5,5-dimethyl-cyclohexane-1,3-dione 0.01; 1,5-dibromo-hexane 0.02; 5-acetylsalicylamide 0.08; 4-bromo-2,3,5,6-tetrafluorobenzonitrile 0.43; 2-(4-chloro-phenyl)-8,8-dimethyl-9-dihydro-7H-pyrazolo[1,5-a]quinazolin-6-one 0.26; 3-phenyl-2-propenoic acid 0.13; 2-(3,4-dimethoxyphenyl)-3,7-dimethoxy-4H-1-benzopyran-4-one 0.19; N-octyl-N-sec-butyl-3-(2-hydroxy-3,4-dimethyl-phenyl)-3-phenyl-propionamide 0.04; nonylamine 0.08; propanedinitrile 0.10; 6-bromo-4-phenyl-quinazoline-2-carbaldehyde oxime 0.1; N-(2-phenylbenzimidazol-6-yl)-acetamide 0.16; 2-butyl-4,5,6,7-tetrahydro-1H-isoindole-1,3(2H)-dione 0.16; 2,3-dihydro-7-hydroxy-2,2-dimethyl-4H-1-benzopyran-4-one 0.02; 3-phenyl-1,2,4-thiadiazol-5-amine 0.08; 4-[(2-hydroxy-5-nitrophenyl)methylenamino]-benzophenone 0.19; (2-bromo-3-methylphenyl)diphenylphosphine 0.01; benzo[1,2,5]oxadiazol-5-ylamine 0.13; 4-amino-2-nitro-phenol 0.13; paroxetine 0.14; N1-[4-(trifluoromethoxy)phenyl]-2-chloroacetamide 0.27; 2-bromo-N-methyl-2-propen-1-amine 0.10; 4-acetamido-N,N-dimethyl-3-nitrobenzamide 0.32; N-methyl-1-adamantaneacetamide 0.12; dyphylline 0.15; 2-(dimethylamino)-1,3-dimethyltetrahydro-1,3,2-diazaphosphole-2-oxid 0.27; 1,2,5a,6,7,8-hexahydro-6,6-dimethyl-cyclopenta[c]pentalen-3(3aH)-one 0.25; alpha-D-glucopyranoside 0.24; 1-octadecanamine 0.14; 2,2-dibutyl-1,2-selenagermolane 0.13; 2-(methylamino)-ethanol 0.09.

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Table Continued...

A

2-methoxy-phenol 5.29; methoxy-phenyl-oxime 0.37; malic acid 0.20; 2-methoxy-4-methyl-phenol 1.02; hexadecane 0.60; 1-bromodocosane 0.10; tetradecane 0.54; 1-methyl-4-(1-methylethyl)-1,3-cyclohexadiene 0.62; 2,6-dimethoxy-phenol 1.03; 4-methoxy-3-(methoxymethyl)-phenol 0.78; heneicosane 0.95; 7-hexyl-tridecane 1.63; 6-methyl-tridecane 0.93; 5-methoxy-4-methyl-1-heptene 0.20; hentriacontane 1.19; hexadecane 0.88; 3,6-dimethyl-undecane 0.32; ethyl tridecanoate 1.99; 5-hydroxy-2-methyl-3-hexenoic acid 0.07; propyl-2-ethylhexanoate 0.57; 9-hydroxy-2-nonanone 0.21; n-propyl-9-tetradecenoate 1.82; hexadecanoic acid, methyl ester 0.92; hexadecanoic acid, ethyl ester 21.41; 3,5-dinitro-benzonitrile 0.05; decanoic acid, methyl ester 0.23; 1-hexadecanol 2.21; eicosane 0.21; ethyl oleate 28.25; heptadecanoic acid, ethyl ester 2.14; octadecanoic acid, ethyl ester 8.96; octahydro-2-methylene-4,7-methano-1H-indene 0.20; nonadecane 0.83; octahydro-4a,5-dimethyl-3-(1-methylethyl)-2(1H)-naphthalenone 1.04.

B

2-methoxy-phenol 6.41; 6-ethoxy-pyridin-2-amine 0.33; 2-methoxy-4-methyl-phenol 3.33; D,L-arabinose 0.27; 1-iodo-tridecane 0.57; 4-ethyl-2-methoxy-phenol 1.42; 3-methyl-5-propyl-nonane 0.28; (+)-4-carene 0.54; 2,6-dimethoxy-phenol 0.98; 4-aminobutanoic acid 0.21; 4-methoxy-2-methyl-1-(methylthio)benzene 0.65; heptadecane 1.07; octadecane 8.18; 5,5-dimethyl-3-(3-methyl-oxiran-2-yl)-cyclohex-2-enone 0.19; N-cyclohexyl-3-nitro-4-pyridinamine 0.60; 3,5-dichloro-2,6-dimethyl-4-pyridyl ester 0.12; 2-bromo dodecane 1.08; docosane 0.71; nonanoic acid, ethyl ester 1.95; 2-methyl-propanamide 0.4; 2,4,6,8-tetramethyl-13-tetradecenoic acid 0.5; 2-dodecanone 0.4; heneicosane 0.89; methyl hexadec-9-enoate 2.02; hexadecanoic acid, ethyl ester 19.26; 2-(p-tolyl)ethylamine 0.08; 9-eicosene 2.62; 2-methyl-decane 0.27; ethyl oleate 28.53; octadecanoic acid, ethyl ester 16.08; 5-acetoxypentadecane 2.10; 2,2-dimethyl-5-methylene-bicyclo[2.2.1]heptane 0.23; Z-7-hexadecenoic acid 1.12; eicosane 1.00; 3,3-dimethyl-2-(phenylselenyl)butanoic acid, 2-methylbutyl ester 0.88.

C

2-methoxy-phenol 3.61; 2-methoxy-4-methyl-phenol 0.91; tetradecane 0.41; 4-ethyl-2-methoxy-phenol 0.72; 4-amino-5-imidazole carboxamide 0.20; hentriacontane 0.35; (+)-4-carene 0.53; 2,6-dimethoxy-phenol 1.00; 2-methoxy-5-nitro-benzenamine 1.15; hexadecane 0.3; octadecane 1.12; N-acetyl-dl-serine, methyl ester 0.44; 3-chloro-1,2-propanediol 0.07; 4-phenyl-pyrimidine 0.01; eicosane 0.67; octacosane 0.56; 3,6-dimethyl-undecane 0.18; tetradecanoic acid, ethyl ester 1.45; N-allyl-oxalic acid, monoamide 0.39; 2-pentadecanone 0.36; octacosane 0.62; E-11-hexadecenoic acid 1.79; hexadecanoic acid 0.12; cyclohexadecane 2.35; 2-methyl-decanoic acid 0.19; eicosane 0.12; 9-octadecenoic acid 30.69; octadecanoic acid 17.85; 15-hydroxypentadecanoic acid 2.84; Z,Z,Z-1,4,6,9-nonadecatetraene 0.22; 1-cyclohexylnonene 0.81; octadecane 0.70; N-ethyl-ethanamine 0.21; 13-octadecenal 1.56; 3-(dimethylamino)-2-propenoic acid, methyl ester 0.74; 3,7-dimethyl-2-octen-1-ol 0.15; benzo(a)pyrene-6-methanol 0.07; 17-hydroxy-pregna-1,4-diene-3,20-dione 0.07; 4-methoxy-6-morpholin-4-yl-[1,3,5]triazine-2-carboxylic acid amide 0.10; methyl 3-diethylphosphonoacrylate 0.10; 6-(2-formylhydrazino)-N,N'-bis(isopropyl)-1,3,5-triazine-2,4-diamine 0.13; benzothiophene-3-carboxylic acid 0.10; 3-hydroxy-4-methoxybenzyl alcohol 0.03; 1,1'-binaphthalene 0.05; 2-hydroxy-1H-isoindole-1,3(2H)-dione 0.06; 1-azido-2-nitro-benzene 0.08; 1-adamantanecarboxanilide 0.10; 11,12-dihydroxyseychellane 0.07; 1',2'-epoxyhexobarbital 0.04; 2-methylaminomethyl-1,3-dioxolane 0.12; 2-acetylamino-3-(4-ethoxy-phenyl)-acrylic acid 0.10; 4-phenyl-3,4-dihydroisoquinoline 0.08; N-methyl-1-adamantaneacetamide 0.12; 1-acetyl-4-[1-piperidyl]-2-butynone 0.05; 2-(benzylideneamino)fluorene 0.04; 2-nitro-benzaldehyde 0.11; N-(2'-acetyl-4',5'-dimethoxyphenyl)-4-methoxy-benzamide 0.05; 3,4-dimethyl-N-(4-methylthiobenzylidene)-benzenamine 0.09; hexahydropyridine 0.06; 1H-pyrazolobisthiolium 0.13; 2-hexadecyl-2,3-dihydro-1H-indene 0.09; 4-[N-methylpiperazino]-5-nitro veratrole 0.05; 7-chloroquinoline-2,4-dicarboxylic acid 0.08; 2-acetylamino-3-(4-ethoxy-phenyl)-acrylic acid 0.08; 3,5-dibromo-4-pyridinol 0.12; 3-O-methyl-D-glucose 0.07; 8-hydro-thiazolo[3,2-a]pyridinium 0.05; p,p'-dibromodiphenyl trichloroethane 0.09; 6-chloro-2-phenethyl-4-phenylquinoline 0.08; 1-amino-2-(hydroxymethyl)anthraquinone 0.2; 3-(4-aminophenyl)-2-phenyl-acrylic acid, methyl ester 0.03; benzo[b]thiophene-4-acetic acid 0.08; 2-isopropylidenehydrazono-3-methyl-4-chloro-2,3-dihydrobenzothiazole 0.10; N-(diphenylethenylidene)-methanamine 0.05; 1,2,4-Oxadiazole-5-carboxamide 0.05; pentachloro-pyridine 0.07; propanamide 0.03; N-methyl-4-pyridinecarboxamide 0.13; 4-acetamido-2-methallylphenol 0.07; 6-chloro-3-ethoxycarbonyl-2-methyl-4-phenylquinoline 0.07; 4-methylthiophene-3-sulfonamide 0.04; 2,2-diphenylpropionitrile 0.08; 1-(5-bromo-4-nitro-2-thienyl)ethan-1-one 0.08.

1A: Minced meat in a shell with *Lactobacillus plantarum+Staphylococcus carnosus*.

1B: With cultures of *Lactobacillus plantarum+Micrococcus varians*.

1C: Minced control in a shell without cultures.

A, B, C: Respectively fermented sausages subjected to smoked.

In Table 2 gives the main "flavor components" of all fermented sausages in comparison with the control. The composition of the present flavoring components mainly includes fat substances fatty acid derivatives, which in the composition are several times larger than other substances from the same but fat-free samples (Table 1). Obtained data seem to suggest that the taste of the national product of Russia - sausage Braunschweigskaya is determined mainly by a combination of basic substances repeated in all samples (Table 2), first of all, the derivatives of fatty acids-decane, hexadecane, 9-octadecene, palmitic , Docosanic, 8,11,14,17-eicosatetraenoic, cis-10-nonenedecene, nonane, dodecanoic, tetradecanoic, cholesterol derivatives and impurities of all other components of flavoring substances 1 and 2, involved in the "composition" of the taste and flavor of sausage Braunschweig. The formation of a flavor-aromatic scale occurs due to the spices used and the enzymatic activity of microbial cultures that break down the constituent parts of meat raw materials[13–15] into organic substances with a characteristic flavor.

Table 2 Basic fragrances of sausages of Braunschweig, mg/kg

Characteristic Peak Identification Time, min	Name of Fragrance	A	B	C
4.117	3-phenyl-1H-quinolin-2-one	-	-	0.12
4.175	1-ethyl-2-phenyl-1H-indole	-	0.51	-
4,631	Decanoic acid, methyl ester	0.06	0.32	0.26
4.683	Nonanoic acid, methyl ester	0.41	1.33	1.53
6.006	Dodecanoic acid, methyl ester	0.57	1.64	1.89

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Table Continued..

Characteristic Peak Identification Time, min	Name of Fragrance	A	B	C
7.215	Methyl tetradecanoate	7.78	6.57	7.89
7.729	Pentadecanoic acid, methyl ester	0.48	-	-
8.149	9-hexadecenoic acid	-	-	3.21
8.175	Methyl hexadec-9-enoate	9.42	5.49	-
8.274	Hexadecanoic acid, methyl ester	13.47	19.53	12.19
8.689	Methyl cis-10-Heptadecenoate	2.32	-	-
8.772	Heptadecanoic acid, methyl ester	3.35	-	-
9.15	Methyl (Z)-9-Octadecenoate	26	18.96	14.79
9.669	Methyl cis-10-Nonadecenoate	1.13	4.69	0.4
9.918	5,8,11,14-Eicosatetraenoic acid	2.81	-	-
9.97	cis-5,8,11-Eicosatrienoic acid	1.65	-	-
9.981	Octadecanoic acid, methyl ester	-	-	0.36
10.027	Octadec-9-en-1-al dimethyl acetal	-	-	2.7
10.053	Z-6,17-octadecadien-1-ol acetate	-	2.48	-
10.074	2-octyl-cyclopropaneoctanoic acid	-	-	4.8
10.079	Methyl cis-13-eicosenoate	12.04	-	-
10.136	Eicosanoic acid	1.85	-	5.78
10.147	3,7,11-trimethyl-2,6,10-dodecatrien-1-ol	-	-	0.46
10.173	2,4-dinitro-5-fluoroaniline	-	0.72	-
10.235	Arachidonic acid	-	6.65	-
10.25	Methyl 7,10,13-Eicosatrienoate	-	-	3.89
10.276	1,9-cyclohexadecadiene	-	3.17	-
10.282	5-nonadecen-1-ol	-	-	10.46
10.307	11-hexadecen-1-ol, acetate	-	6.66	-
10.411	6-octadecenoic acid, methyl ester	-	-	1.16
10.416	Methyl 18-methylnonadecanoate	-	3.35	-
10.697	Methyl 8,11,14,17-eicosatetraenoat	0.61	0.4	3.73
10.774	9-octadecenal	4.46	-	-
10.832	Ethyl 5,8,11,14,17-icosapentaenoat	-	4.11	7.23
10.847	Palmitoyl chloride	1.87	0.15	0.19
10.883	2,3-dihydroxypropyl elaidate	-	-	8.27
10.889	1-cyclohexylnonene	-	6.67	-
10.925	Docosanoic acid	0.27	0.56	0.82
10.951	D-gulopyranoside	-	2.59	2.99
11.791	10-nonadecenoic acid, methyl ester	-	-	0.32
11.885	Tetracosanoic acid, methyl ester	-	-	0.17
15.382	Cholesterol	0.1	0.41	0.63
20.296	1-docosene	0.11	-	-
20.301	Octacosyl acetate	-	0.21	-
20.306	13-tetradecen-1-ol acetate	-	-	0.24

A: Sausage product with *Lactobacillus plantarum +Staphylococcus carnosus*.

B: Sausage product with cultures of *Lactobacillus plantarum +Micrococcus varians*.

C: Control without crops.

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Conclusion

Thus, the targeted introduction of certain microbial cultures allows us to adjust the flavor and aroma of national meat products, due to the presence of traditional spices.

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Conflict of interest

The author declares no conflict of interest.

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