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Described are aqueous emulsions which comprise an oily substance in combination with an emulsifier, the emulsifier being selected from phospholipids, and lecithins in particular being employed. Aqueous lecithin-containing emulsions of this kind are particularly suitable for lubricating conveyor systems, especially those which transport receptacles containing foods.

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(57) Abstract: Described are aqueous emulsions which comprise an oily substance in combination with an emulsifier, the emulsifier being selected from phospholipids, and lecithins in particular being employed. Aqueous lecithin-containing emulsions of this kind are particularly suitable for lubricating conveyor systems, especially those which transport receptacles containing foods.

WO 2008/019797 A3

Lecithin emulsions as conveyor system lubricants

The present invention relates to a lubricant composition and to its use for lubricating conveyor systems, preferably for lubricating conveyor systems for packaging, and especially for food packaging.

In the packaging of food and drink, and particularly in bottling and kegging halls of beverage plants, the vessels in question are typically transported using plate conveyor belts or other conveyor systems, which are lubricated and at the same time kept clean using suitable lubricant preparations, preferably via automatic belt lubricators featuring spraying systems.

Lubrication is needed in order to reduce the friction between the conveyor systems and moving or stationary components of the system, and also to prevent the receptacles transported being able to fall over and become damaged in the event of a rapid change in speed. A lubricating film on the surface of the conveyor systems has the effect, for example, of reducing the friction between the receptacles and the surfaces of the conveyor systems, so that if, say, the conveyor belt is halted rapidly, the static friction of the transported container is reduced and hence the danger of a fall can be reduced.

The performance requirements imposed on such lubricants, however, are manifold. The lubricants are required primarily to bring about a reduction in friction, and this frictional reduction must also care for different materials. Bearing in mind that the receptacles transported on conveyor systems of this kind are composed not only of glass and metal but also of paperboard or cardboard, and that at the same time it is also necessary to ensure frictional reduction of metal components with one another, and also the fact that the surface of the conveyor systems is composed, for example, of plastic or metal plates or of rubber, it is apparent that not all of the known lubricants are capable of fulfilling these tasks. A further factor is that, in practice, the lubricants may form foam, which is unwanted. Although in principle this problem can be solved by adding defoamers and/or low-foaming surfactants, such defoamers and the surfactants frequently lack the desired high biodegradability. The accompanying use of amines, especially fatty amines, is also undesirable on environmental grounds. For the development of a suitable lubricant, therefore, it is not possible to use all of the compounds which are known in principle.

The prior art has already disclosed a variety of proposed solutions. For example, **EP 0 359145 A1** proposes using aqueous, soap-free lubricant compositions which give clear solutions in water and have a pH in the range from 6 to 8 and which, moreover, comprise alkylbenzenesulphonates and alkoxylated alkanol phosphates, and also alkanecarboxylic acids. **WO 2005/014764** discloses lubricant concentrates which necessarily comprise at least one organic monoester or diester in combination with at least one anionic surfactant, these concentrates having to be diluted by mixing with water to give the desired lubricants.

In practice, however, the problem continues to occur that the lubricants adhere too strongly to the surfaces for example, and hence that excessive adhesion of the transported receptacles, or sticking, may occur. On the other hand, the excessively easy removal of the lubricants from the conveyor belts, at high speeds with resultant centripetal forces, for example, is likewise undesirable, in order to prevent the lubricants spraying around the conveyor system.

It was an object of the present invention, therefore, to improve on the disadvantages, outlined above, of the prior art lubricants. It has now been found that certain emulsifiers in aqueous emulsions are suitable for achieving the stated object.

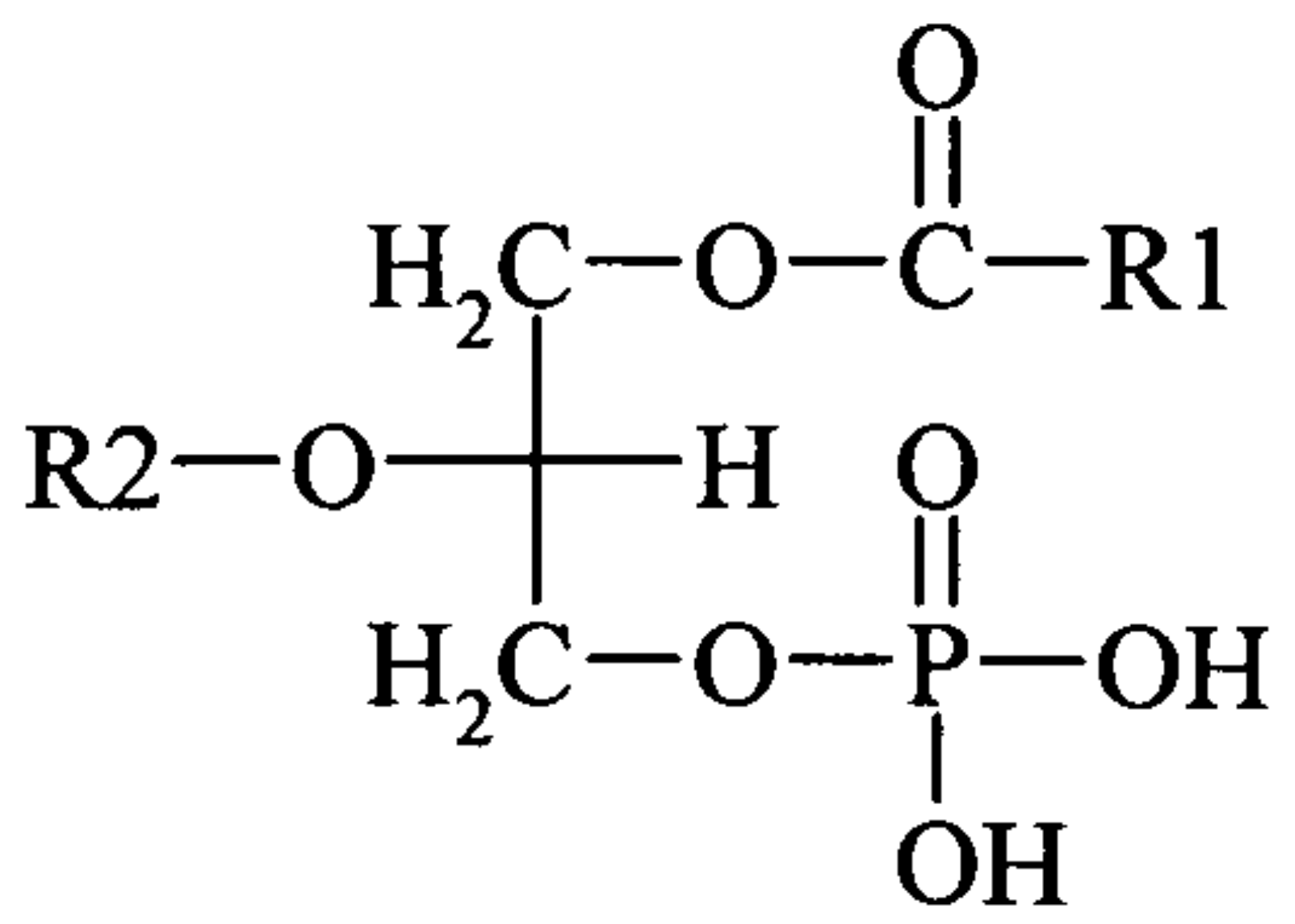
The present specification firstly provides for the use of dispersions which comprise a lipophilic phase and a water phase, and also a dispersant or emulsifier, the dispersion necessarily comprising as dispersant/emulsifier at least one phospholipid, and for the use of such dispersions as lubricants, preferably as conveyor system lubricants.

The compositions used in accordance with the invention take the form of dispersions. A dispersion is in principle a system (disperse system) composed of two or more phases of which one is continuous (dispersion medium) and at least one other is finely divided (dispersed phase, dispersoid). Examples of dispersions include the following: emulsions (dispersion medium and dispersed phase: liquid phases insoluble in one another), aerosols [gaseous dispersion medium, liquid dispersed phase (mist) or solid dispersed phase (smoke, dusts)], and suspensions (liquid dispersion medium, solid dispersed phase). For the inventive use it has proved to be particularly advantageous for the compositions to take the form of emulsions, either of the oil-in-water (O/W) type or of the water-in-oil (W/O) type.

Especial preference is given to emulsions of the O/W type, in other words where the lipophilic phase is dispersed and is surrounded by a continuous aqueous phase.

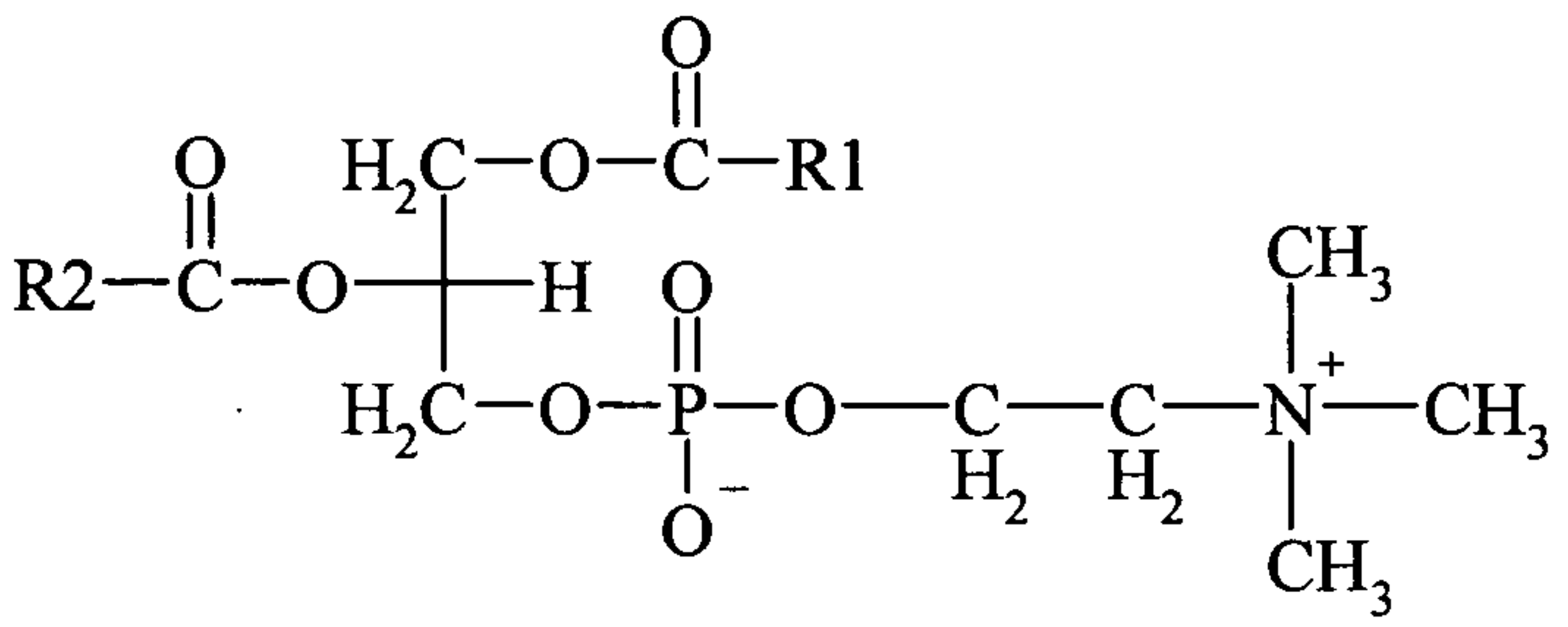
The dispersions (preferably emulsions) of the present technical teaching contain preferably between 70% and 90% by weight of water. In practice, however, such compositions are diluted with water to form suitable lubricants, which then typically also include between 15% and 0.001% by weight, preferably between 10% and 0.01% by weight, of non-aqueous constituents.

As an essential constituent the dispersions of the invention comprise at least one phospholipid emulsifier/dispersant. Phospholipids are complex lipids in which one of the primary hydroxyl groups of the glycerol is esterified with phosphoric acid, which is esterified in turn. The other two hydroxyl groups of the glycerol are esterified with long-chain saturated or unsaturated fatty acids. Phospholipids are diesters or monoesters of phosphoric acid which on account of their fatlike solubility properties, owing to the liphophilic and hydrophilic components, are classed with the lipids and which as membrane lipids, within the body, are involved in the construction of layer structures, the membranes. Phosphatidic acids are glycerol derivatives which are esterified with fatty acids in positions 1-sn and 2 (1-sn position: usually saturated, 2 position: usually mono- or polyunsaturated) but at the 3-sn atom are esterified with phosphoric acid, and which are characterized by the general structural formula



In the phosphatidic acids which occur in human or animal tissue the phosphate radical is usually esterified with amino alcohols such as choline (lecithin = 3-sn-phosphatidylcholine) or 2-aminoethanol (ethanolamine) or L-serine (cephalin = 3-sn-phosphatidylethanolamine or sn-phosphatidyl-L-serine), with myo-inositol to form the phosphoinositides [1-(3-sn-phosphatidyl)-D-myo-inositols], which are frequent in tissues, or with glycerol to form phosphatidylglycerols.

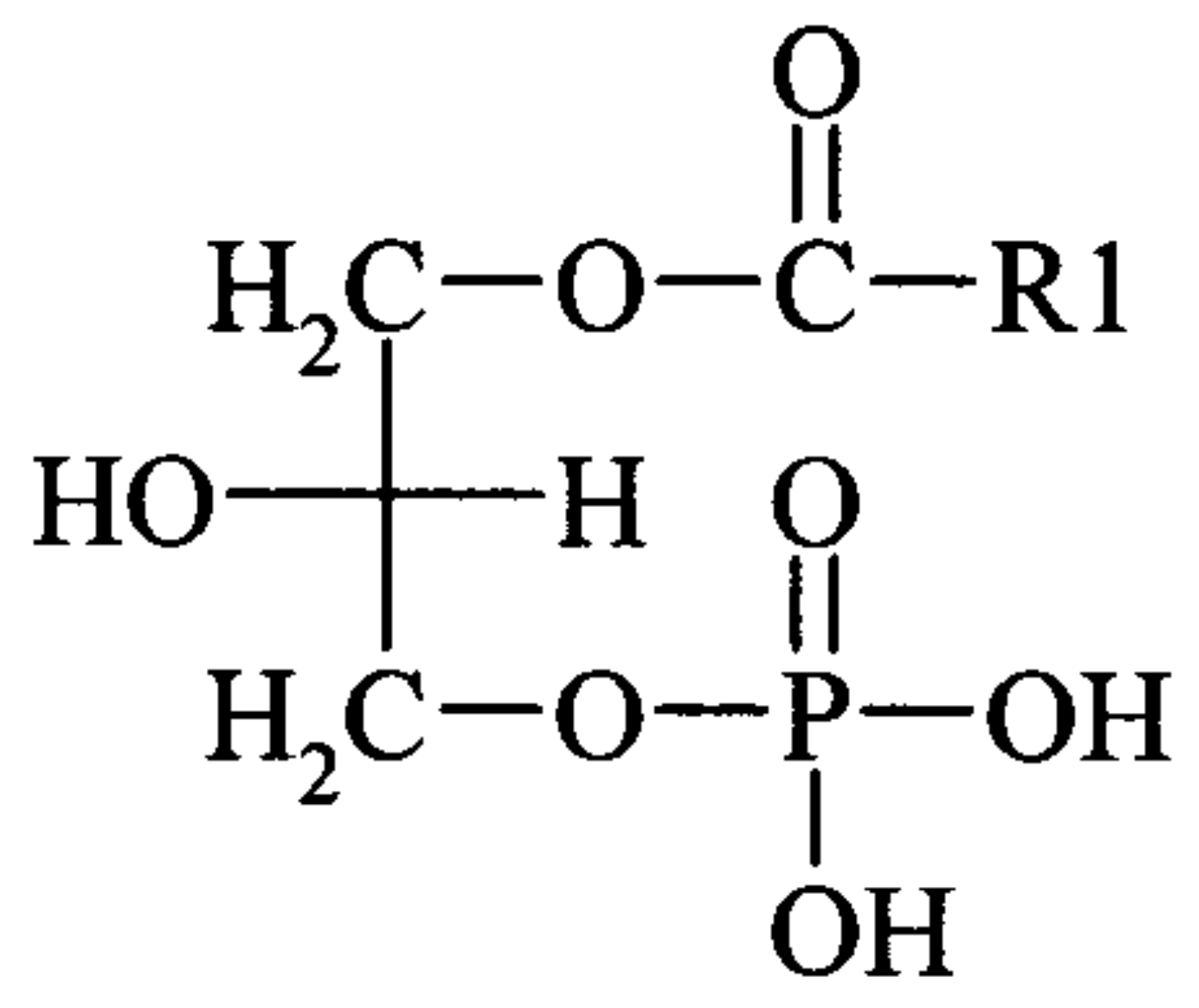
Lecithins, whose use in the dispersions of the invention is particularly preferred, are characterized by the general structural formula



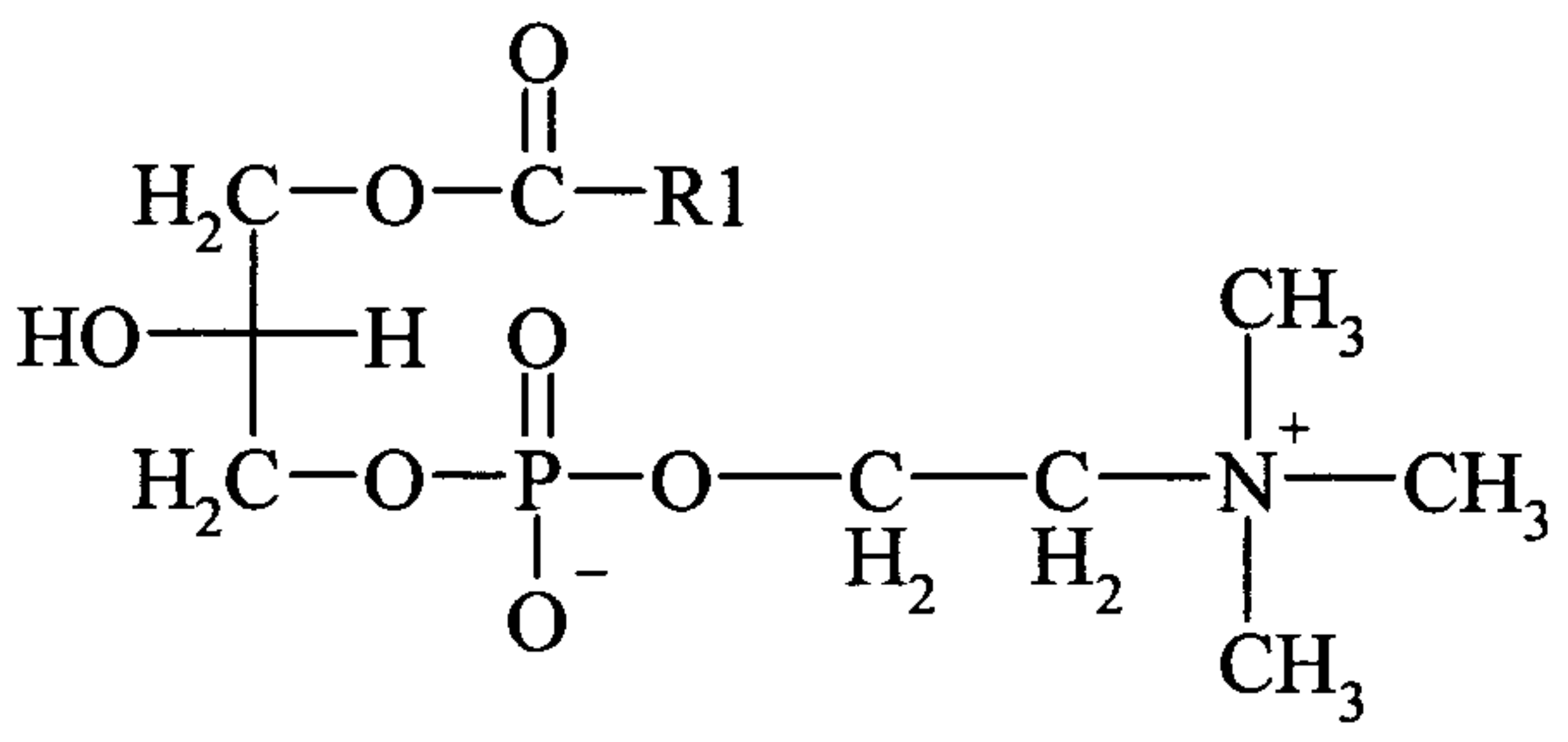
where R1 and R2 are typically unbranched aliphatic radicals having 15 or 17 carbon atoms and up to 4 cis double bonds.

Cardiolipins (1,3-bisphosphatidylglycerols) are phospholipids composed of two phosphatidic acids linked via glycerol. Lysophospholipids are obtained when an acyl radical is eliminated from phospholipids by phospholipase A (e.g. lysolecithins).

Lysophospholipids are characterized by the general structural formula



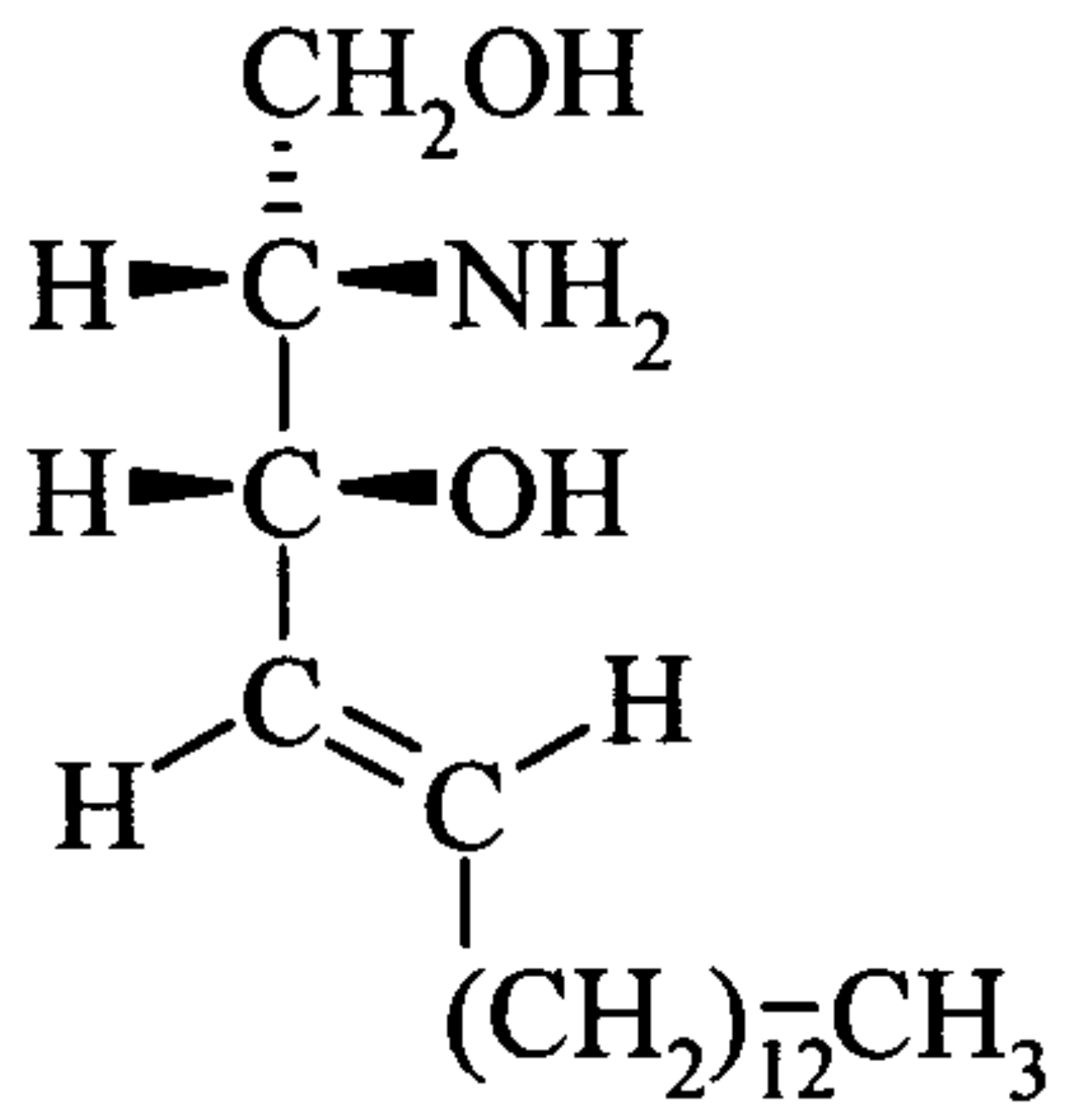
Lysolecithins, for example, are characterized by the general structural formula



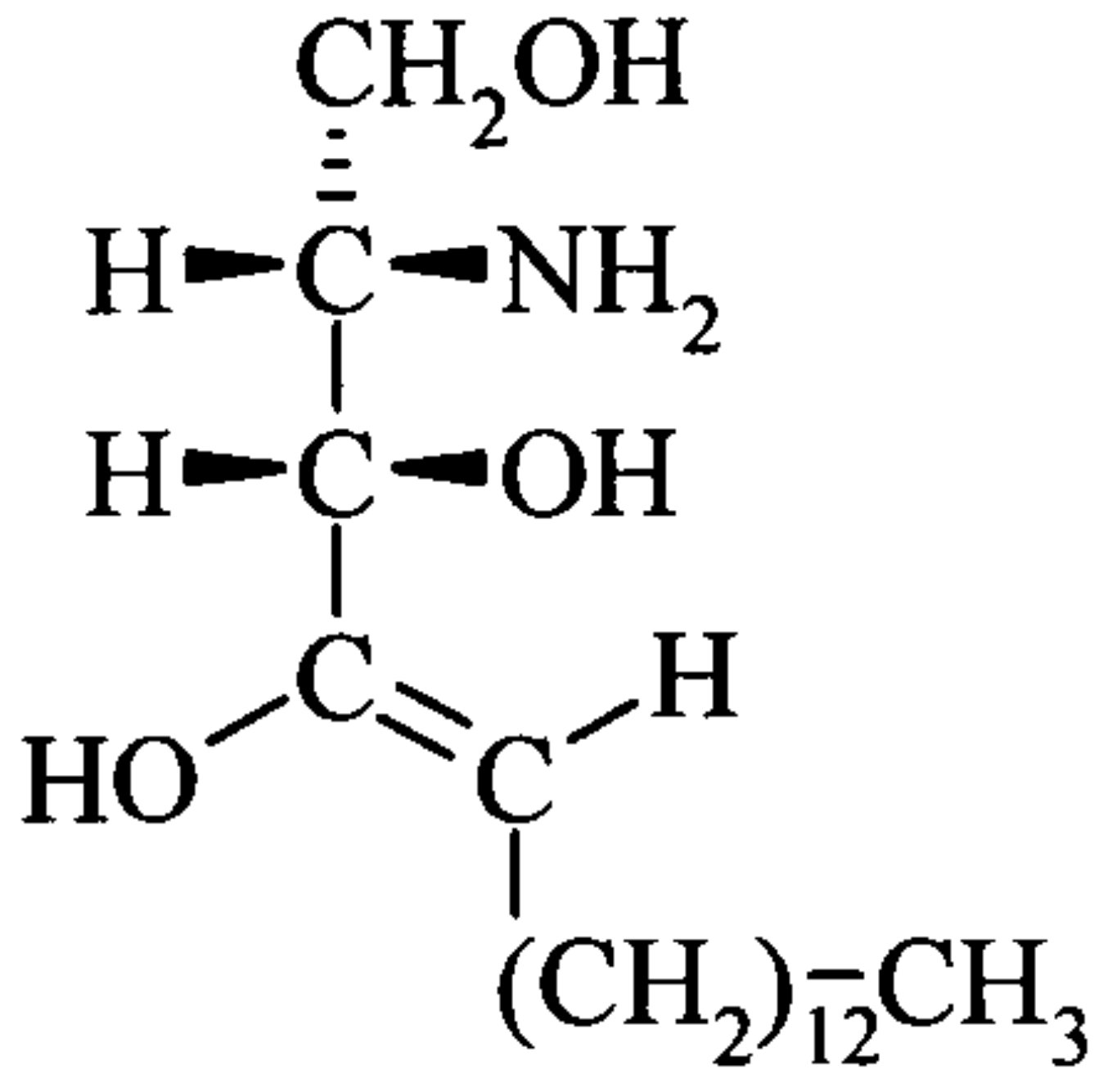
where R1 and R2 are typically unbranched aliphatic radicals having 15 or 17 carbon atoms and up to 4 cis double bonds.

The phospholipids also include plasmalogens, in which instead of a fatty acid in position 1 an aldehyde (in the form of an enol ether) is attached; the O-1-sn-alkenyl compounds corresponding to the phosphatidylcholines, for example, are called phosphatidalcholines.

The parent structure of the phosphosphingolipids is sphingosine or else phytosphingosine, which are distinguished by the following structural formulae:

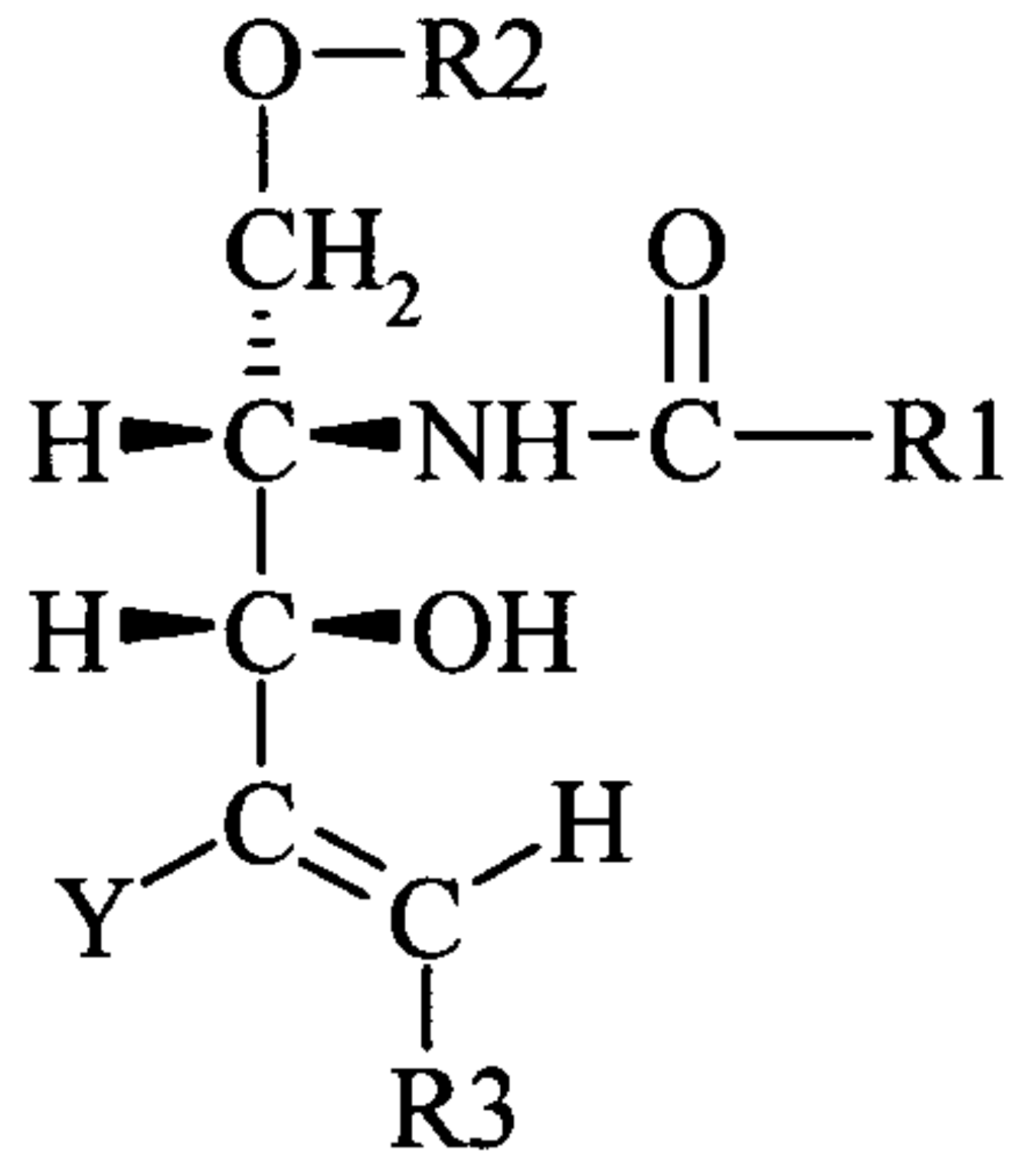


(sphingosine)



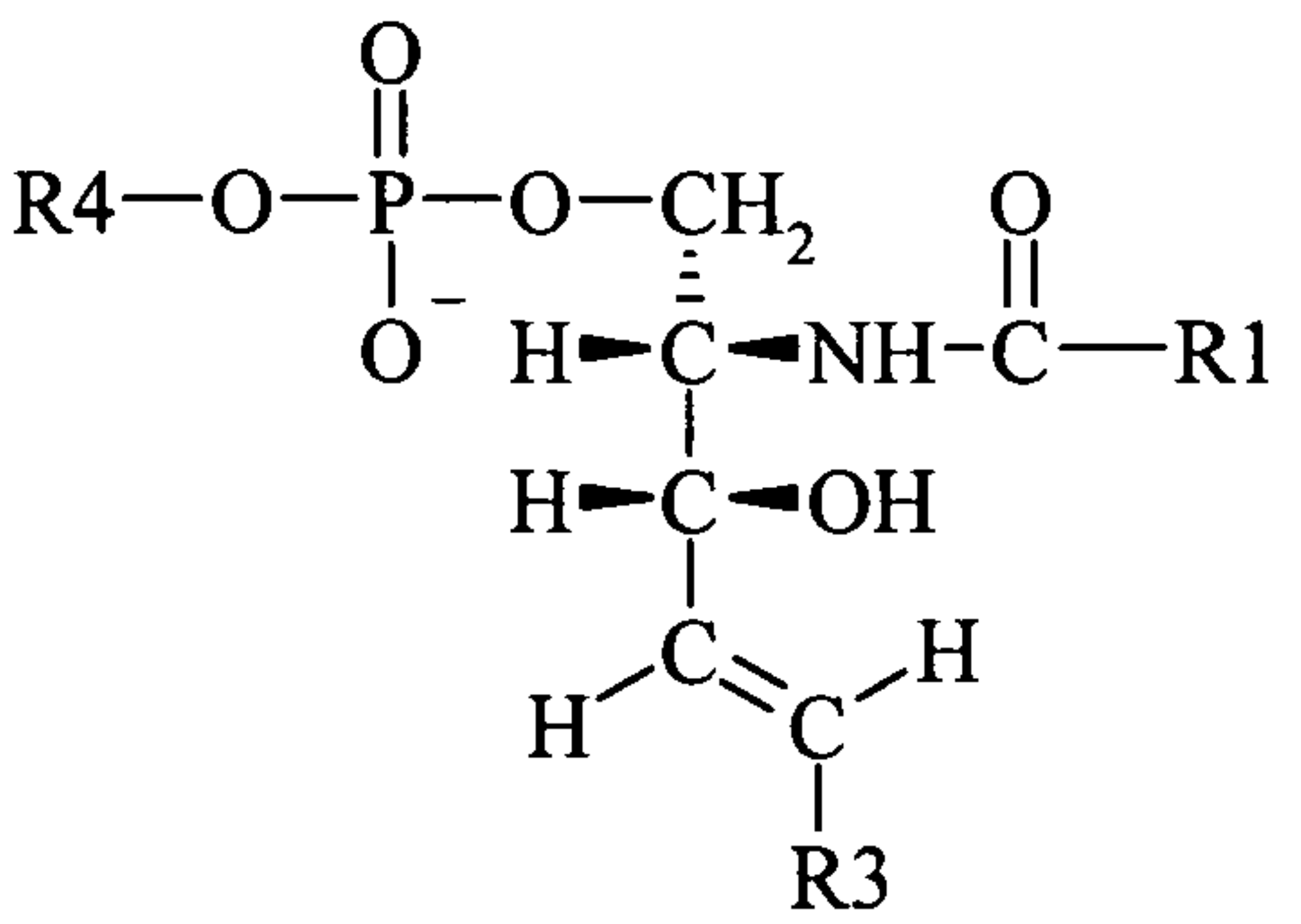
(phytosphingosine)

Modifications of sphingolipids are distinguished for example by the general parent structure

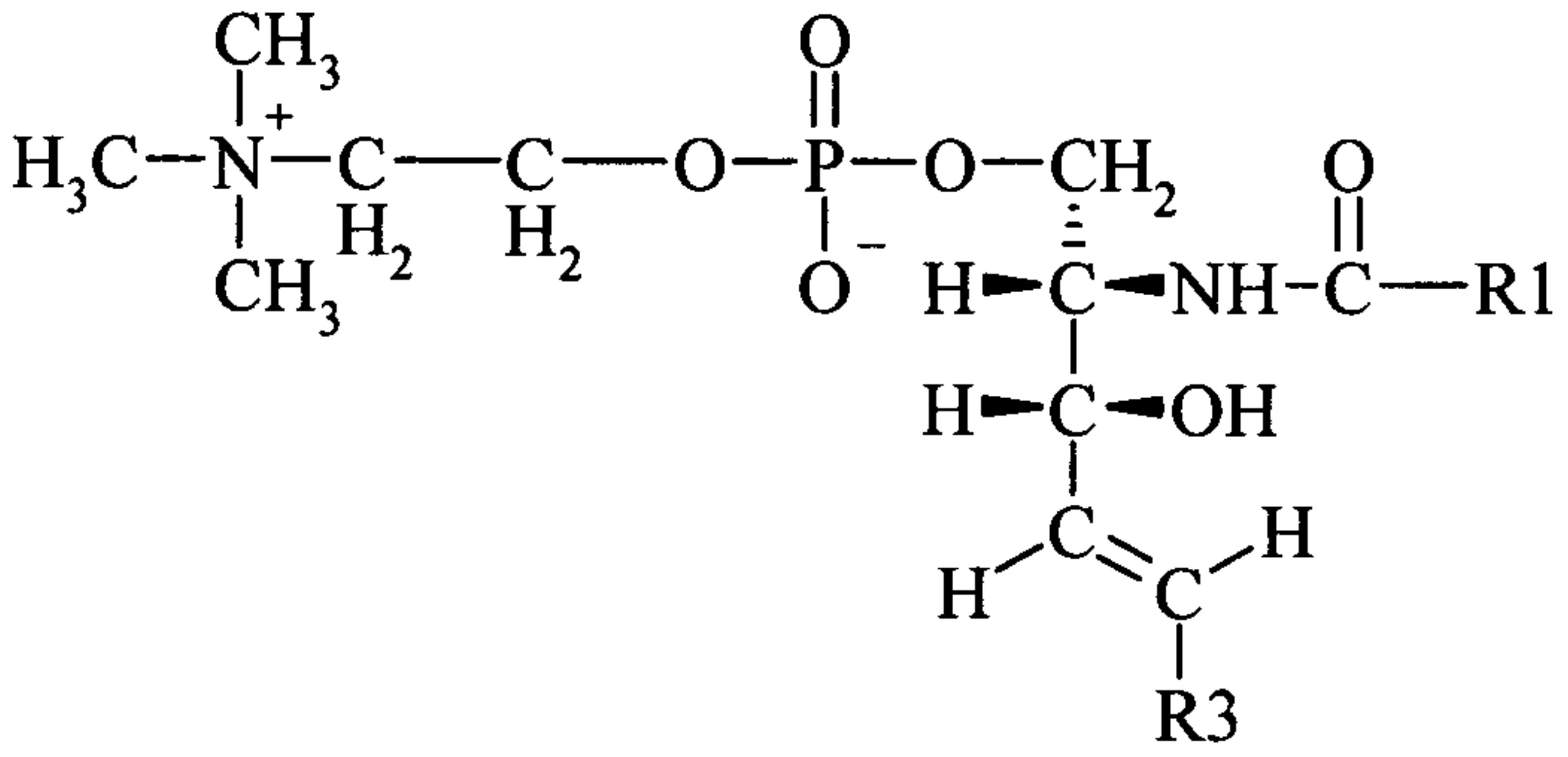


in which R1 and R3 independently of one another are saturated or unsaturated, branched or unbranched alkyl radicals of 1 to 28 carbon atoms and R2 is selected from the following group: hydrogen atom, saturated or unsaturated, branched or unbranched alkyl radicals of 1 to 28 carbon atoms, sugar radicals, phosphate groups unesterified or esterified with organic radicals, sulphate groups unesterified or esterified with organic radicals; and Y is either a hydrogen atom, a hydroxyl group or another hetero-functional radical.

Sphingophospholipids:



R1 and R3 are alkyl radicals, R4 is an organyl radical. Sphingomyelins are organylphosphorylated sphingolipids of the type



For the purposes of this invention, the term phospholipids also encompasses phosphosphingolipids and sphingophospholipids.

One preferred embodiment of the invention uses phospholipids of plant origin. These phospholipids may be obtained, for example, from soya or other plant seed cells. It is advantageous to use lecithins which are obtained as by-products in the refining of plant oils (particularly of soya oil). Soya lecithins are composed of phosphatidylcholine (40-50%), phosphatidylethanolamine (about 10%), phosphatidylinositol (about 5%), phosphatidylserine (about 1-2%) and also sterols and fat. Phospholipids for use advantageously and preferably are selected from phospholipids which have been deoiled and/or fractionated and/or spray-dried and/or acetylated and/or hydrolysed and/or hydrogenated. Phospholipids whose use is advantageous are also selected from phospholipids which are phosphatidylcholine-enriched and/or phosphatidylinositol-enriched.

Phospholipids whose use is advantageous in accordance with the invention are particularly those available commercially under the trade names Leciprime^{TM}1800 IP (from Cargill), Phosal^{TM}50 SA+ (from Phospholipid), Soluthin^{TM}MD (from Phospholipid) or Lipoid^{TM} SL 80-3 (from Lipoid).

The amount of the phospholipids (one or more compounds) in the emulsions is preferably 0.01% to 10%, more preferably 0.1% - 8%, in particular 0.5% - 5%, in particular 2% to 4%, by weight, based on the total weight of the emulsion.

The dispersions of the invention comprise a lipophilic phase. The lipophilic phase may comprise oil components and/or fats and also any desired mixtures thereof. Depending on the choice of lipophilic phase, the dispersions of the invention take the form of suspensions and/or emulsions. "Oils" (used synonymously: oil component) are water-insoluble organic compounds which are liquid at 30°C and have a relatively low vapour pressure. The common feature of the oils is not their matching chemical constitution but instead their similar physical consistency.

Particularly preferred lipophilic phases are those which are liquid at room temperature (21°C). The compositions of the present teaching are preferably emulsions which are prepared by liquid starting materials. Suspensions are therefore less suitable. The skilled person will therefore select suitable oil phases on the basis of their melting points.

Examples of suitable oil components include the classes of compound specified below, provided that they are liquid at 30°C and preferably at 21°C. Examples are Guerbet alcohols based on fatty alcohols having 6 to 18, preferably 8 to 10, carbon atoms (e.g. Eutanol® G), esters of linear C_6-C_{22} fatty acids with linear or branched C_6-C_{22} fatty alcohols, or esters of branched C_6-Co carboxylic acids with linear or branched C_6-C_{22} fatty alcohols, such as, for example, myristyl myristate, myristyl palmitate, myristyl stearate, myristyl isostearate, myristyl oleate, myristyl behenate, myristyl erucate, cetyl myristate, cetyl palmitate, cetyl stearate, cetyl isostearate, cetyl oleate, cetyl behenate, cetyl erucate, stearyl myristate, stearyl palmitate, stearyl stearate, stearyl isostearate, stearyl oleate, stearyl behenate, stearyl erucate, isostearyl myristate, isostearyl palmitate, isostearyl stearate, isostearyl isostearate, isostearyl oleate, isostearyl behenate, isostearyl oleate, oleyl myristate, oleyl palmitate, oleyl stearate, oleyl isostearate, oleyl oleate, oleyl behenate, oleyl erucate, behenyl myristate, behenyl palmitate, behenyl stearate, behenyl isostearate, behenyl oleate, behenyl behenate, behenyl erucate, erucyl myristate, erucyl palmitate, erucyl stearate, erucyl isostearate, erucyl oleate, erucyl behenate and erucyl erucate. Also suitable are esters of linear C_6-C_{22} fatty acids with branched alcohols, especially 2-ethylhexanol, esters of C_3-C_{38} alkylhydroxycarboxylic acids with linear or branched C_6-C_{22} fatty alcohols, and especially dioctyl malate, esters of linear and/or branched fatty acids with polyhydric alcohols (such as propylene glycol, dimer diol or trimer triol, for example) and/or Guerbet alcohols, triglycerides based on C_6-C_{10} fatty acids, liquid mono-/di-/triglyceride mixtures based on C_6-C_{18} fatty acids, esters of C_6-C_{22} fatty alcohols and/or Guerbet alcohols with aromatic carboxylic acids, especially benzoic acid, esters of C_2-C_{12} dicarboxylic acids with linear or branched alcohols having 1 to 22 carbon atoms or polyols having 2 to 10 carbon atoms and 2 to 6 hydroxyl groups, vegetable oils, branched primary alcohols, substituted cyclohexanes such as 1,3-dialkylcyclohexanes, linear and branched C_6-C_{22} fatty alcohol carbonates, such as dicaprylyl carbonate (Cetiol® CC), Guerbet carbonates based on fatty alcohols having 6 to 18, preferably 8 to 10, carbon atoms, esters of benzoic acid with linear and/or branched C_6-C_{22} alcohols (e.g. Finsolv® TN), linear or branched, symmetric or asymmetric dialkyl ethers having 6 to 22 carbon atoms per alkyl group, such as dicaprylyl ether (Cetiol® OE), ring-opening products of epoxidized fatty acid esters with polyols (Hydagen® HSP, Sovermol® 750, Sovermol® 1102), silicone oils (cyclomethicones, silicon methicone types, etc.) and/or aliphatic or naphthenic hydrocarbons, such as mineral oil, squalane, squalene or dialkylcyclohexanes, for example.

Particularly preferred are mixtures of triglycerides or partial glycerides, particular preference being given to those glycerides prepared by esterifying glycerol with fatty acids of the general formula R-COOH in which R stands for saturated or unsaturated, branched or linear alkyl oe alkenyl radicals which have 5 to 21 carbon atoms and preferably between 5 and 19 carbon atoms. It is preferred to use mixtures of triglycerides and partial glycerides, and mixtures of partial glycerides (i.e. mono- and/or diglycerides) are also suitable. Additionally preferred are those glycerides which have exclusively saturated fatty acid radicals. Likewise preferred are those glycerides whose fatty acids come from plant sources, coconut oil for example. Here as well it is the case that glycerides liquid at room temperature are preferred as oil phases.

Suitable silicone oils, besides dimethylpolysiloxanes, methylphenylpolysiloxanes and cyclic silicones, are amino-, fatty acid-, alcohol-, polyether-, epoxy-, fluoro-, glycoside-and/or alkyl-modified silicone compounds, which at room temperature may be either liquid or resinous. Also suitable are simethicones, which are mixtures of dimethicones having an average chian length of 200 to 300 dimethylsiloxane units with silicon dioxide or hydrogenated silicates. Other suitable oily substances include polycarbonates. A particularly suitable polycarbonate is the copolymer whose INCI designation is hydrogenated dimer dilinoleyl/dimethyl carbonate copolymer, available as commercial product Cosmedia® DC from Cognis Deutschland GmbH & Co. KG.

Dialkyl ethers, dialkyl carbonates, triglyceride mixtures and esters of C_8-C_{24} fatty acids and C_8-C_{24} fatty alcohols, polycarbonates, and a mixture of these substances are likewise suitable as oily substances in acordance with the invention. The dialkyl carbonates and dialkyl ethers may be symmetrical or symmetrical, branched or unbranched, saturated or unsaturated, and are preparable by reactions which are sufficiently well known from the prior art. In accordance with the invention it is preferred to use a mixture of oily substances that includes esters, dialkyl ethers and triglycerides.

In accordance with the invention it is possible to employ, inter alia, hydrocarbons which are liquid at 30°C and preferably at 21°C, having a chain length preferably of 8 to 40 carbon atoms. They may be branched or unbranched, saturated or unsaturated. Preference among them is given to branched, saturated C_8-C_{20} alkanes. It is possible to use not only pure substances but also substance mixtures. The compounds in question are typically substance mixtures composed of different isomeric compounds. Compositions which contain alkanes having 10 to 30, preferably 12 to 20 and more preferably 16 to 20 carbon atoms are particularly suitable, and particular suitability among these is possessed by a mixture of alkanes which includes at least 10% by weight of branched alkanes, based on the total amount of the alkanes. The alkanes in question are preferably branched, saturated alkanes.

The lipophilic phase accounts for between 0.1% and 50%, preferably 0.5% to 25% and in particular from 1.0% to 15% by weight of the dispersion.

Besides the abovementioned ingredients of water, emulsifier and oily substance, the dispersions of the invention may further comprise further ingredients that are typical for lubricants. Thus, on the one hand, there may be further emulsifiers in the dispersion, in addition to the phospholipids, preference possibly being given to nonionic emulsifiers, although cationic or amphoteric emulsifiers may also be present. The accompanying use of anionic emulsifiers and/or surfactants or soaps is not preferred in accordance with the invention. Preference is instead given to those dispersions which are free from such anionic surfactants or soaps.

Typical examples of suitable nonionic emulsifiers are fatty alcohol polyglycol ethers, alkylphenol polylglycol ethers, fatty acid polyglycol esters, fatty acid amide polyglycol ethers, fatty amine polyglycol ethers, alkoxylated triglycerides, mixed ethers or mixed formals, optionally partially oxidized alk(en)yloligoglycosides or glucoronic acid derivatives, fatty acid N-alkylglucamides, protein hydrolysates (especially wheat-based plant products), polyol fatty acid esters, sugar esters, and among them preferably sorbitan esters, polysorbates and amine oxides. Where the nonionic surfactants contain polyglycol ether chains, these chains may have a conventional, but preferably a narrowed, homologue distribution.

Particularly preferred emulsifiers are alkyl(oligo)glycosides which conform to the formula (I)

$$R^1O\text{-}[G]_p \qquad (I)$$

in which R^1 is an alkyl and/or alkenyl radical having 4 to 22 carbon atoms, G is a sugar radical having 5 or 6 carbon atoms and p stands for numbers from 1 to 10, and ethoxylated sorbitan esters.

In the dispersions used in accordance with the invention for lubricating conveyor systems it is additionally possible for there to be further ingredients present, customary per se, which are selected preferably from the group of biocides, antistats, antifoams or defoamers, thickeners, solubilizers, hydrotropes, pH regulators, corrosion inhibitors, builder substances, complexing agents or preservatives. Preferably, however, the compositions are free from defoamers.

Additives of the kind listed above are present typically in amounts of max. 10% by weight, based on the total amount of the dispersion, preferably in amounts of 0.01% to 5% by weight and in particular in amounts of 0.1% to 3% by weight in total in the dispersions. The pH of the aqueous dispersions ought preferably to be situated in the range from 6 to 8.

Additionally it may be advantageous if as well as the constituents described above, glycerol is also used. The glycerol may in that case be present in amounts of preferably 0.1% to 10% but especially in amounts of 1% to 5% by weight.

The inventive use relates preferably to the lubrication of conveyor systems whose surface comprises plastic and/or metal. It is preferred, moreover, to use the dispersions to lubricate those conveyor systems which transport receptacles, preferably those of glass or plastic, especially polyalkylene terephthalate (PET), or, preferably, bottles of glass or plastic, especially those of PET.

The dispersions of the invention have a very special advantage when the conveyor systems transport food receptacles and where there is a risk that the conveyor systems or the receptacles will come into contact with foods, and hence a correspondingly compatible lubricant is required.

The dispersions employed inventively as lubricants are preferably in the form of aqueous emulsions. As outlined above, these emulsions are supplied in concentrated form. The water content of such concentrates is preferably 50% by weight or more. Particular preference is given to those aqueous emulsions or dispersions which contain at least 70% by weight of water and preferably at least 80% by weight of water. The emulsions may also, however, contain up to 90% by weight of water. The concentrates can then be diluted with water to the respective use concentration.

One parameter for describing dispersions or the size distribution of the dispersed particles is the Sauter diameter. The Sauter diameter is defined as the diameter of a drop having the same ratio of drop volume to drop surface area as the ratio occurring as the average value in the dispersion as a whole.

The Sauter diameter is defined mathematically as D[3,2]:

$$D[3,2] = \bar{d}_{srn} = \frac{\sum s_i d_i}{S} = \frac{\sum n_i d_i^3}{\sum n_i d_i^2}$$

in which s_i, is the total surface area, $n_i \Pi d^2$, of the particles within the group i, and S is the total surface area of the total population. In one preferred embodiment of the invention the Sauter diameter $d_{3,2}$ of the dispersion is less than or equal to 400 nm, in particular less than or equal to 200 nm.

A parameter for describing dispersions (especially emulsions), or the size distribution of the dispersed particles, is the breadth of the droplet size distribution. The breadth of the droplet size distribution can be described by the quantity known as BTV value:

$$BTV = \frac{d_{3,90} - d_{3,10}}{d_{3,50}}$$

d	drop diameter
$d_{3,90}$	90% of the volume of the disperse phase is formed by drops with d <= $d_{3,90}$
$d_{3,50}$	50% of the volume of the disperse phase is formed by drops with d <= $d_{3,50}$
$d_{3,10}$	10% of the volume of the disperse phase is formed by drops with d <= $d_{3,10}$

The smaller the BTV figure, the narrower the droplet size distribution. The dispersions of the invention preferably have a BTV value of less than or equal to 2, in particular less than or equal to 1.

In a preferred embodiment, the dispersions have an average droplet size in the range from 0.3 to 0.05 μm, preferably from 0.2 to 0.08 μm and in particular from 0.15 to 0.1 μm.

The dispersions of the invention are prepared by homogenizing the immiscible phases. Homogenization or dispersion takes place where appropriate at temperatures greater than room temperature (21°C) and/or at increased pressures. If homogenization is carried out with an increased temperature, the dispersion is cooled to room temperature again after the dispersing operation. In dispersion technology, homogenizing means the ultrafine comminution of the disperse phase of a crude emulsion. In this case, for the liquid/liquid dispersion, the droplet size spectrum of the crude emulsion shifts significantly in the direction of smaller drops. Drop comminution produces new phase boundaries, which must be occupied completely and quickly by emulsifier molecules, since in this way the newly formed drop is better stabilized and, on account of the lower interfacial tension, can be comminuted further more easily. The dispersions of the invention can be obtained in accordance with the typical emulsifying techniques. One exemplary process for preparing the dispersions of the invention is carried out by combining the water phase and also the mixture comprising emulsifier and the lipophilic phase, and carrying out homogenization with an energy input of 1×10^5 to 2×10^8 J/m^3.

Homogenizing apparatus used may comprise high-pressure dispersing systems such as radial diffusers with a flat or jagged valve; opposed-jet dispersers such as the microfluidizer, for example, jet dispersers or baffle systems. Further suitable dispersing systems include rotor stator systems, ultrasonic systems, ball mills or membranes.
When high-pressure dispersing systems are used as homogenizing apparatus, the operation takes place at pressures of 50 to 2500 bar, preferably 200 to 800 bar and in particular 400 to 600 bar.
In the case of emulsion preparation by means of micromixers, a pressure range of 2 to 30, preferably of 5 to 20, bar is typical. Micromixers have the advantage of producing finely divided and narrow particle size distributions at low pressures in a particularly gentle way.
In one preferred embodiment of the process of the invention the homogenization is carried out by means of high-pressure homogenization. The advantage of high-pressure homogenization is that it is very easy to form small droplets having a very narrow size distribution, which is advantageous if the intention is to prepare phase-stable dispersions of low viscosity. On account of the performance advantages of an emulsion prepared by high-pressure homogenization, attempts are also being made increasingly in the cosmetic industry to use homogenizing techniques of this kind. Owing to the fact that a new interface is formed with particular rapidity, the requirements imposed on emulsifier and carrier phase are exacting, since the emulsifiers must occupy the interface spontaneously and very rapidly in order to ensure optimum phase stability.

In order to obtain finely divided dispersions having a monomodal and narrow particle size distribution, in particular with a BTV value of less than or equal to 2, it may be advantageous to combine different emulsifying methods with one another. For example, a preliminary dispersion can be prepared in a stirring vessel and then homogenized by dispersing in a single pass by means of a rotor-stator system and subsequently by means of of a high-pressure homogenizer. A single pass here means a procedure in which the entire contents of a vessel are run once through the homogenizing apparatus into another vessel. In contrast to what is called the circulation mode, this ensures that each element of liquid has passed through the homogenizing apparatus once. There are no coarse emulsion droplets remaining which can form the starting point for the breakdown of the dispersion.

For preliminary dispersion it is preferred to use rotor-stator systems. Rotor-stator systems may be apparatus such as toothed colloid mills or machines which consist of one or more rotors and stators having passage openings in the form of slots or cylindrical or rectangular holes, such as those of the Cavitron^{TM}, Supraton^{TM}, Siefer^{TM}, Bran+Lübbe^{TM}, IKA^{TM}, Koruma^{TM} or Silverson^{TM} type etc. In one preferred embodiment of the invention the homogenizing step or steps are run through two or more times.

In one embodiment of the invention the dispersions of the invention can be prepared by preparing concentrates and then diluting them with water. This may be of advantage in particular in the case of dispersions having a low final lipophilic-phase concentration.

The dispersions of the invention are much more stable on storage than other known emulsions of the prior art. They take the form preferably of amine-free compositions.

The invention lastly provides a method of lubricating conveyor belts and conveyor systems by diluting a composition in water as described above and then applying the diluted composition to the conveyor belts or conveyor systems that are to be lubricated, said application taking place preferably by means of spraying.

Examples

Two inventive emulsions were prepared and tested for their lubricating action.

1. <u>Preparation of the emulsions</u>

Seven inventive emulsions were prepared by mixing in a high-pressure homogenizer. The droplet size of the oil phase of the emulsion is <0.3 μm with a mean of 0.104 μm and a median at 0.102 μm. The resulting d value (more precisely $d_{3,90}$ value) describes how 90% of the volume of the disperse (emulsified) phase is formed by droplets having a diameter <= $d_{3,90}$.

The particle size distribution was determined using a Beckmann Coulter^{TM} LS 230 instrument, using the optical model Emulsiond.rfd PIDS included (of 14.8.2001) according to the operating instructions (1994). The measurement medium used was water. The particle size is measured immediately after the preparation of the dispersions. In accordance with the instrument manufacturer's instructions, the dispersions measured were in each case dilute; in other words, an amount of the dispersions was introduced into distilled water with stirring until the instrument-specific saturation concentration was displayed by the instrument.

The table below describes the compositions of the emulsions (amounts in % by weight). The ingredients employed were as follows: as soya lecithin, Leciprime 1800 IP from Cargill; as glyceride mixtures, Cegesoft FR57, Myritol^{TM} 312 and Myritol 331 from Cognis; as coemulsifiers, ethoxylated sorbitan monostearate: Tween 80^{TM} and Tween 60; as preservative; Uniphen P-23.

		1	2	3	4	5	6	7
Distilled water	[%]	87.70	88.20	84.00	87.00	87.00	85.70	88.20
Soya lecithin	[%]	10.00	10.00	4.00	2.00	2.00	2.00	10.00
Cegesoft FR57	[%]	–	–	10.00	–	–	–	–
Myritol 312	[%]	–	–	–	10.00	–	–	–
Myritol 331	[%]	–	–	–	–	10.00	10.00	–
Tween 80	[%]	1.00	0.50	–	–	–	–	–
Tween 60	[%]	–	–	2.00	1.00	1.00	1.00	0.50
Uniphen P-23	[%]	1.30	1.30	–	–	–	1.30	1.30
Pressure	[bar]	750 / 50[1] 5 times	750 / 50[1] 5 times	750 / 50[1] 5 times	750 / 50[1] 5 times	750 / 50[1] 2 times	450 / 50[1] 5 times	450 / 50[1] 5 times
Homogenizer		APV LAB 60	APV LAB 60	APV LAB 60	APV LAB 60	APV LAB 60	APV LAB 60	APV LAB 60
Particle diameter d_{90}	[nm]	174	213	211	169	160	177	206
Sauter diameter $d_{3,2}$	[nm]	125	136	111	130	122	135	145
BTV		0.615	0.822	1.176	0.311	0.517	0.507	0.653
Sauter diameter d3,2 after 8 weeks at RT[3]	[nm]	132	122	–	–	–	–	–
Sauter diameter d3,2 after 8 weeks at 45°C	[nm]	143	133	–	–	–	–	–

[1] High-pressure homogenizer

[2] Ultra Turrax™; IKA T50; tool S50N-G40G; 5200 rev.min^{-1}

[3] RT = Room temperature

2. Performance testing:

The inventive compositions 6 and 7 were tested in comparison to the following formulations 8 and 9, which represent the prior art. Composition 9 is a suspension of solids in water, and is therefore not an emulsion:

Composition 8

Water	47.0% by weight
Isopropanol 1	0.0% by weight
Emulsifier (Glucopon^{TM} 600 UP)	18.0% by weight
Oleic acid	15.0% by weight
KOH (45%)	6.0% by weight
Monoethanolamine	4.0% by weight

Composition 9

Water	91.23% by weight
Cetyl palmitate	4.44% by weigh
Glyceryl stearate	0.33% by weight
Behenyl alcohol, ethoxylated (10 EO)	1.33% by weight
Preservative	2.0% by weight

2.1 Test of storage stability at 4O^{0}C

The compositions were stored at a constant temperature of 40°C. After a week a visual inspection was made as to whether phase separation had occurred. Compositions 6 and 7 in comparison were tested in relation to comparative formulation 9:

	Storage stability at 40°C after 1 week	Storage stability at 40°C after 4 weeks	Storage stability at 40°C after 12 weeks
Composition 6	+	+	+
Composition 7	+	+	+
Composition 8	Phase separation	Phase separation	Phase separation

2.2 Lubrication experiments

The efficacy of compositions 6 and 7 in terms of lubricating action is tested in comparison to the comparative formulations 8 and 9. The table below shows the results of a lubricating experiment carried out at a lubricant concentration of 500 ppm, in other words a diluted solution:

	Plastic chain material, water	Steel chain material, water	Steel chain material, 16° dH*
Composition 6	++	++	++
Composition 7	++	++	++
Composition 8	0	0	0
Composition 9	+	0	+

* dH = German hardness measure

The table shows the friction coefficients viewed relatively. The abbreviations have the following meanings:

++: much better than the comparative formulation
+: better than the comparative formulation
0: the same as the comparative formulation

2.3 Material compatibility:

The material compatibility was determined using the method described below. At the area of potential contact in practice, the PET bottles under test are dipped in the concentrated product under investigation (e.g. chain lubricant) and then exposed to CO_2. After a defined exposure period, the concentrated product is rinsed off with water. As soon as the bottles are dry, they are inspected. The test was carried out specifically as follows:

1. 9 PET bottles are tested per product
2. first of all the bottles are filled with water up to 2-3 cm below the rim
3. subsequently the bottle bases are immersed for 5 seconds to a depth of approximately 5 cm in the concentrated lubricant (the base of the bottle must be fully wetted)
4. excess lubricant is allowed to drip from the bottle base (approximately 10 seconds)
5. the bottles are closed with the coupling in the form of the top-mounted connection with shut-off tap, and are adjoined to the CO_2 connection

6. the pressure reduction valve is set at $\Delta p=7.5$ and the PET bottle is slowly (approximately 30 seconds) brought to an internal pressure of $\Delta p=7.5$ bar
7. the bottle is shaken to continue its exposure to CO_2 until CO_2 is no longer dissolved
8. the bottles are stored at room temperature for 72 hours under a constant pressure of $\Delta p=7.5$ bar ± 0.2 bar
9. slow (approximately 30 seconds) aeration to $\Delta p=0$ bar
10. bottles are emptied and rinsed clean with water

The references used are 3 bottles which are tested in the same way with an established chain lubricant. The evaluation is made by visually assessing the base of the bottle for leaks, stress cracking and clouding. This involves differentiation into four or five categories and also in 3 zones.

Categories for stress corrosion cracking		*Zones*	*Leakage*
0	no damage	stand surface	yes
A	slight damage	radial base	no
B	moderate, superficial cracks	centre bottom	
C	several moderately deep cracks		
D	several deep cracks		

Compositions 6 and 7 showed little to no damage only in the stand surface zone, and can therefore be classed as compatible for PET material.

WHAT IS CLAIMED IS:

1. Use of an emulsion as a lubricant, the emulsion comprising 0.1 to 50% by weight of a lipophilic phase, at least 50% by weight of a water phase, and 0.01 to 10% by weight of at least one emulsifier, wherein the at least one emulsifier comprises a phospholipid, wherein the lipophilic phase comprises partial esters or full esters of glycerol with fatty acids of the general formula R-COOH, R being saturated or unsaturated, branched or linear alkyl or alkenyl radicals which contain 5 to 21 carbon atoms, and wherein the emulsion is free of anionic surfactant and alkyl amines.

2. The use according to claim 1, wherein the emulsion is an oil-in-water (O/W) or water-in-oil (W/O) emulsion.

3. The use according to claim 1 or 2, wherein the lipophilic phase further comprises glycerol.

4. The use according to any one of claims 1-3, wherein the phospholipid is a lecithin.

5. The use according to claim 4, wherein the lecithin is soy lecithin.

6. The use according to any one of claims 1-5 wherein the emulsion has an average droplet size in the range of 0.3 to 0.05 μm.

7. The use according to claim 6, wherein the average droplet size is in the range of 0.2 to 0.08 μm.

8. The use according to claim 6, wherein the average droplet size is in the range of 0.15 to 0.1 μm.

9. The use according to any one of claims 1-8, wherein the droplets in the emulsion have a Sauter diameter $d_{3;2}$ of less than 400nm.

10. The use according to claim 9, wherein the Sauter diameter is less than 200nm.

11. The use according to claim 1, wherein the lipophilic phase accounts for between 0.5% and 25% by weight of the emulsion.

12. The use according to claim 1, wherein the lipophilic phase accounts for between 1.0% and 15% by weight of the emulsion.

13. The use according to any one of claims 1-12, wherein the phospholipid is present in an amount of between 0.01% and 10% by weight in the emulsion.

14. The use according to claim 13, wherein the phospholipid is present in an amount of between 0.1% and 8% by weight in the emulsion.

15. The use according to claim 13, wherein the phospholipid is present in an amount of between 0.5% and 5% by weight in the emulsion.

16. The use according to claim 13, wherein the phospholipid is present in an amount of between 1.0% and 3.0% by weight in the emulsion.

17. The use according to any one of claims 1-16, wherein the emulsion comprises at least 70% by weight of water.

18. The use according to claim 17, wherein the emulsion comprises at least 80% by weight of water.

19. The use according to any one of claims 1-18, wherein the emulsion further comprises additional emulsifiers.

20. The use according to any one of claims 1-19, wherein the emulsion further comprises at least one surfactant.

21. The use according to claim 20, wherein the at least one surfactant is selected from the group consisting of non-ionic, cationic, and amphoteric surfactants.

22. The use according to any one of claims 1-21, wherein the emulsion further comprises additional ingredients selected from the group consisting of biocides, antistats, antifoams, thickeners, solubilizers, hydrotropes, pH regulators, corrosion inhibitors, builder substances, complexing agents and preservatives.

23. The use according to any one of claims 1-22, wherein the emulsion is for use as a conveyor system lubricant.

24. The use according to claim 23, wherein the conveyor system comprises a plastic or metal surface.

25. The use according to claim 23 or 24, wherein the conveyor system is for transporting containers.

26. The use according to claim 25, wherein the containers are made from glass or plastic.

27. The use according to claim 25 or 26, wherein the containers are bottles.

28. The use according to any one of claims 23-27, wherein the conveyor system comes into direct contact with foods.

29. The use according to any one of claims 1-28, wherein the emulsion is first diluted with water to form a diluted emulsion, prior to use as a lubricant.

30. The use according to claim 29, wherein the diluted emulsion contains between 0.001% and 15% by weight of the emulsion as defined in any one of claims 1-22.

31. A method of lubricating a conveyor belt, comprising the steps of diluting the emulsion as defined in any one of claims 1-22 and applying the diluted emulsion to a conveyor belt.