Safety Assessment of Lecithin and Other Phosphoglycerides as Used in Cosmetics

Status:	Draft Report for Panel Review
Release Date:	November14, 2014
Panel Date:	December 8-9, 2014

The 2014 Cosmetic Ingredient Review Expert Panel members are: Chair, Wilma F. Bergfeld, M.D., F.A.C.P.; Donald V. Belsito, M.D.; Ronald A. Hill, Ph.D.; Curtis D. Klaassen, Ph.D.; Daniel C. Liebler, Ph.D.; James G. Marks, Jr., M.D.; Ronald C. Shank, Ph.D.; Thomas J. Slaga, Ph.D.; and Paul W. Snyder, D.V.M., Ph.D. The CIR Director is Lillian J. Gill, D.P.A. This report was prepared by Wilbur Johnson, Jr., M.S., Senior Scientific Analyst, and Bart Heldreth, Ph.D., Chemist.

1620 L STREET, NW, SUITE 1200 ◊ WASHINGTON, DC 20036-4702 ◊ PH 202.331.0651 ◊ FAX 202.331.0088 ◊ CIRINFO@CIR-SAFETY.ORG

Commitment & Credibility since 1976

Memorandum

To: CIR Expert Panel Members and Liaisons
From: Wilbur Johnson, Jr.
Senior Scientific Analyst
Date: November 14, 2014
Subject: Draft Report on Lecithin and Other Phosphoglycerides

A Scientific Literature Review (SLR) on Lecithin and other Phosphoglycerides was issued on September 14, 2014. Use concentration data were received from the Council prior to issuance of the SLR, and updated data were received during the 60-day comment period. Specifications for lecithin and related phosphoglycerides were also received from the Council. This safety assessment (draft report) is identified as lecith122014rep in the pdf document.

Included in this package for your review is the Draft Report (lecith122014rep pdf file), the CIR report history (lecith122014hist pdf file), Literature search strategy (lecith122014strat pdf file), Ingredient Data profile (lecith122014prof pdf file), 2014 FDA VCRP data (lecith122014FDAdata pdf file), Comments from the Council (lecith122014pcpc1 pdf file), Use Concentration data (lecithl122014data1 and lecith122014 data2 pdf files), and Specifications on lecithin and related phosphoglycerides (lecith122014data3 pdf file). Comments received from the Council (lecith122014pcpc1pdf file) have been addressed.

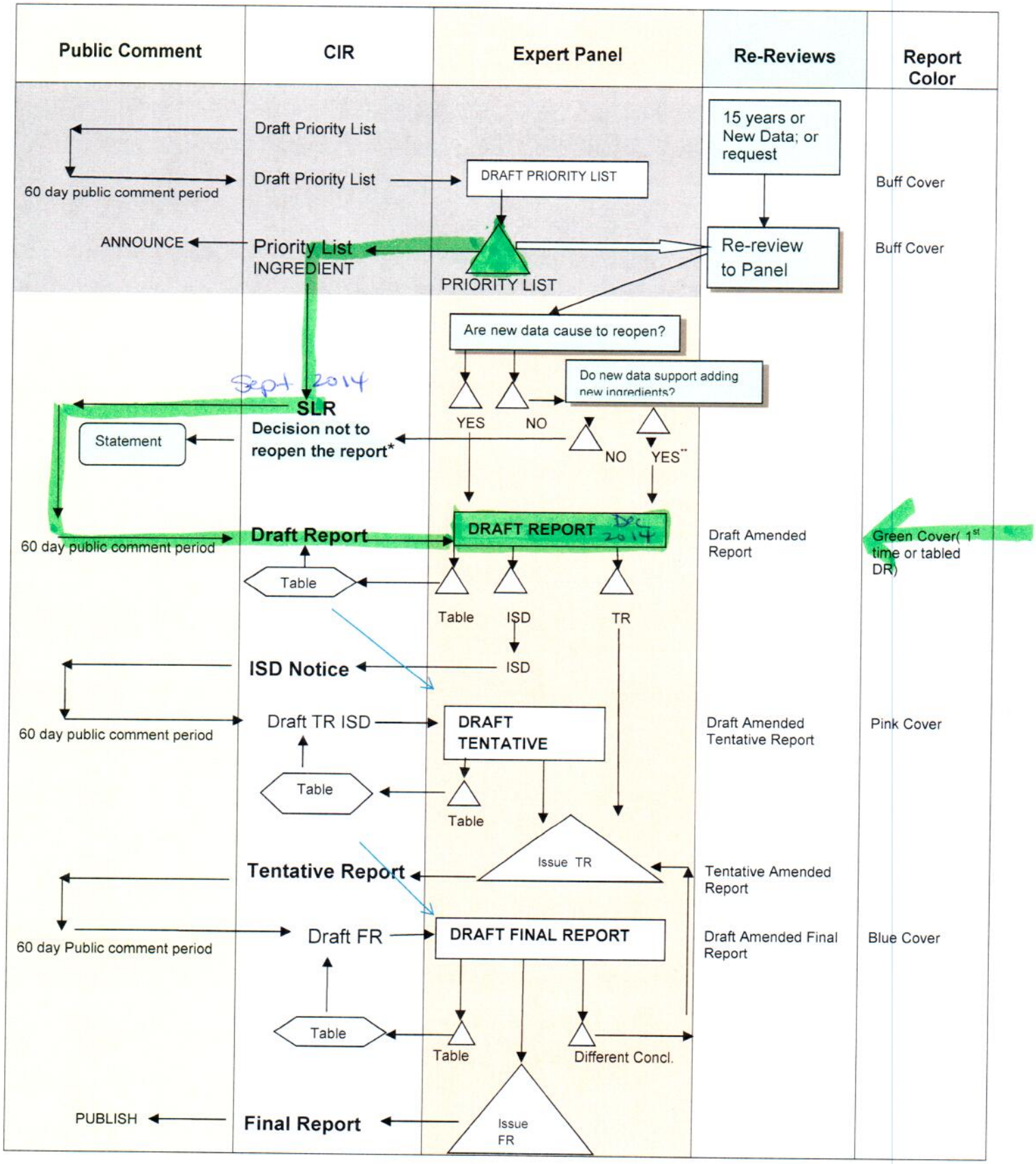
After considering the data included in this safety assessment, the Panel needs to determine whether an insufficient data announcement should be issued, or whether the available data are sufficient for issuing a tentative report with a safe as used, safe with qualifications, or unsafe conclusion on these ingredients.

1620 L Street, N.W., Suite 1200, Washington, DC 20036
(Main) 202-331-0651 (Fax) 202-331-0088
(Email) cirinfo@cir-safety.org (Website) www.cir-safety.org

Phospholycerides

SAFETY ASSESSMENT FLOW CHART

Dec 2014



*The CIR Staff notifies of the public of the decision not to re-open the report and prepares a draft statement for review by the Panel. After Panel review, the statement is issued to the Public.

**If Draft Amended Report (DAR) is available, the Panel may choose to review; if not, CIR staff prepares DAR for Panel Review.

CIR History of:

Lecithin and Other Phosphoglycerides

A scientific literature review (SLR) on Lecithin and other Phosphoglycerides was issued on September 14, 2014. Use concentration data were received from the Council prior to issuance of the SLR, and updated data were received during the 60-day comment period. Specifications for lecithin and related phosphoglycerides were also received from the Council.

Draft Report, Belsito and Marks Teams/Panel: December 8-9, 2014

The Draft Report contains the use concentration data and specifications on Lecithin and related Phosphoglycerides that were received from the Council. Comments received from the Council have been addressed.

Lecithin and Other Phosphoglcerides Check List for December, 2014. Analyst – Wilbur Johnson																				
			Acute toxicity					Repeated dose toxicity				Irritation			Sensitization					
	Skin Penetration	Penetration Enhancement	ADME	Oral	Parenteral	Dermal	Inhale	Oral	Parenteral	Dermal	Inhale	Ocular Irritation	Dermal Irr. Animal	Dermal Irr Human	Sensitization Animal	Sensitization Human	Repro/Devel toxicity	Genotoxicity	Carcinogenicity	Phototoxicity
Lecithin			X					X				X	X	X		X			X	X
Hydrogenated Lecithin													X	X		X		X		X
Lysolecithin			X											X						
Hydrogenated Lysolecithin																				
Phospholipids			X																X	
Hydrolyzed Phospholipids																				
Phosphatidic Acid			X					X												
Lysophosphatidic Acid																	X			
Phosphatidylglycerol																				
Lysophosphatidyl-glycerol																				
Phosphatidylserine			X	X	X			X	X								X	X		
Ammonium Phosphatidyl Rapeseedate																				
Phosphatidylcholine								X			X									
Hydrogenated Phosphatidylcholine																				
Hydrogenated Lysophosphatidyl-choline																				
Lysophosphatidyletha-nolamine																				
Phosphatidylinositol								X												

Literature Searches on Lecithin and Other Phosphoglycerides (8/14/2014)

SciFinder/PubMed Searches

Search Terms

Lecithin
Hydrogenated Lecithin
Lysolecithin
Hydrogenated Lysolecithin
Phospholipids
Hydrolyzed Phospholipids
Phosphatidic Acid
Lysophosphatidic Acid
Phosphatidylglycerol
Lysophosphatidylglycerol
Phosphatidylserine
Ammonium Phosphatidyl Rapeseedate
Phosphatidylcholine
Hydrogenated Phosphatidylcholine
Hydrogenated Lysophosphatidylcholine
Lysophosphatidylethanolamine
Phosphatidylinositol

Search Updates

Search updated on 10/30/2014

Safety Assessment of Lecithin and Other Phosphoglycerides as Used in Cosmetics

Status: Draft Report for Panel Review
Release Date: November14, 2014
Panel Date: December 8-9, 2014

The 2014 Cosmetic Ingredient Review Expert Panel members are: Chair, Wilma F. Bergfeld, M.D., F.A.C.P.; Donald V. Belsito, M.D.; Ronald A. Hill, Ph.D.; Curtis D. Klaassen, Ph.D.; Daniel C. Liebler, Ph.D.; James G. Marks, Jr., M.D.; Ronald C. Shank, Ph.D.; Thomas J. Slaga, Ph.D.; and Paul W. Snyder, D.V.M., Ph.D. The CIR Director is Lillian J. Gill, D.P.A. This report was prepared by Wilbur Johnson, Jr., M.S., Senior Scientific Analyst, and Bart Heldreth, Ph.D., Chemist.

1620 L STREET, NW, SUITE 1200 ◊ WASHINGTON, DC 20036-4702 ◊ PH 202.331.0651 ◊ FAX 202.331.0088 ◊ CIRINFO@CIR-SAFETY.ORG

INTRODUCTION

The safety of lecithin and other phosphoglycerides, listed below, in cosmetics is reviewed in this safety assessment. These 17 ingredients function mainly as skin and hair conditioning agents, emulsifying agents and surfactants in cosmetic products.

- Lecithin
- Hydrogenated Lecithin
- Lysolecithin
- Hydrogenated Lysolecithin
- Phospholipids
- Hydrolyzed Phospholipids
- Phosphatidic Acid
- Lysophosphatidic Acid
- Phosphatidylglycerol
- Lysophosphatidylglycerol
- Phosphatidylserine
- Ammonium Phosphatidyl Rapeseedate
- Phosphatidylcholine
- Hydrogenated Phosphatidylcholine
- Hydrogenated Lysophosphatidylcholine
- Lysophosphatidylethanolamine
- Phosphatidylinositol

The Cosmetic Ingredient Review (CIR) Expert Panel has evaluated the safety of lecithin and hydrogenated lecithin in cosmetics and issued a final report (published in 2001) with the following conclusion: Lecithin and hydrogenated lecithin are safe as used in rinse-off products, safe for use in leave-on products at concentrations of ≤ 15%, and the data are insufficient to determine the safety of use in cosmetic products where lecithin and hydrogenated lecithin are likely to be inhaled; lecithin and hydrogenated lecithin should not be used in cosmetic products in which *N*-nitroso compounds may be formed.[1] Some of the data in the final report are included (italicized in text) in this safety assessment on lecithin and other phosphoglycerides.

CHEMISTRY

Definition and Structure

The ingredients in this report are glycerides of fatty acids, linked to phosphoric acid or to a phosphoric ester. Lecithin, for example, is a naturally occurring mixture of the diglycerides of stearic, palmitic, and oleic acids, linked to the choline ester of phosphoric acid, and is found in plants and animals.[1] In naturally occurring lecithins, the phosphoric acid is attached to the glycerol at the α-position. However, the phosphoric acid can also be attached in the *β*-position of glycerin.[2] The structures of α- and *β*-lecithin are shown in Figure 1.

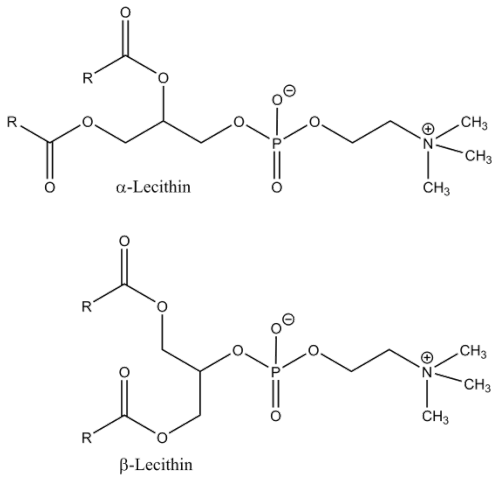


Figure 1. Positional isomers of Lecithin, wherein RC(O)- represents the residue of a fatty acid.

Hydrogenated lecithin (CAS No. 92128-87-5) is the end product of the controlled hydrogenation of lecithin.[1]

Despite the ionic, or even zwitterionic, natures of these ingredients, they are mostly insoluble in water.[3] These ingredients typically are waxy, hygroscopic substances that swell in contact with water to form liposomes.

The main sources of naturally-occurring phosphoglycerides, such as lecithin, as used in personal care products, are soybean, maize, and egg yolk.[4] Synthetic phosphoglycerides can be produced via phospholipase D-catalyzed transphosphatidylation of phosphatidylcholine (which is abundant in soy lecithin) with the desired phosphate substituent (e.g., myo-inositol for the synthesis of phosphatidylinositol).[5]

The definitions, structures and functions of the phosphoglycerides reviewed in this safety assessment are included in Table 1.[6] There is some overlap among the ingredients in this report. While phosphatidylserine and phosphatidylcholine are listed as separate ingredients, they are likely components of the ingredient phospholipids.

Chemical and Physical Properties

Specifications for lecithin and related ingredients are presented in Table 2.[7,8,9,10,11,12,13,14,15,16] Included are chemical and physical properties data and microbiological specifications. In Table 2, measurements of toluene-insoluble or hexane-insoluble matter indicate the total impurity content (including protein) of lecithin and related ingredients.

Method of Manufacture

Lecithin and Lecithin (enzyme-modified)

Commercial lecithin is isolated as a gum following hydration of solvent-extracted soy, safflower, or corn oils.[17] Lecithin is bleached, if desired, by hydrogen peroxide and benzoyl peroxide and dried by heating. During the manufacture of lecithin derived from soy, most, if not all, of the soy protein is removed. If present, soy allergens would be found in the protein fraction.[18] According to another source, soy lecithin is usually produced from the hexane extract of soybean.[19]

In addition to the commercial lecithin mentioned above, it should be noted that another form of lecithin, enzyme-modified lecithin, is prepared by treating lecithin with either phospholipase A2 or pancreatin.[20]

Phosphatidylserine

Soy-derived phosphatidylserine (phosphatidylserine complex derived from soy lecithin) consists of serine-substituted soy lecithin phospholipids and other phospholipids occurring naturally in lecithin.[21] Production of such soy lecithin phosphatidylserine complex involves the enzymatic transphosphatidylation of phosphatidylcholine and phosphatidylethanolamine from soy lecithin (via cabbage-derived phospholipase in the presence of exogenous serine) to phosphatidylserine. The production of the phosphatidylserine-enriched complex proceeds without the use of solvents during the manufacturing process. Thus, the final soy lecithin phosphatidylserine complex is solvent-free.

Composition/Impurities

Lecithin and Lecithin (enzyme-modified)

Commercial lecithin is a naturally-occurring mixture of the phosphatides of choline, ethanolamine, and inositol, with smaller amounts of other lipids.[17] Practically all of the lecithin in commerce is derived from soybeans. Phosphoglycerides are the major constituents of lecithin, and commercial lecithin may contain up to 35% triglycerides.[22]

As an approved direct food additive for human food consumption, lecithin (enzyme-modified) meets the following specifications:[20]

- Acetone-insoluble matter (phosphatides), not less than 50%
- Acid value, not more than 40
- Lead, not more than 1.0 part per million, as determined by atomic absorption spectroscopy
- Heavy metals (as Pb), not more than 20 ppm
- Hexane-insoluble matter, not more than 0.3%
- Peroxide value, not more than 20
- Water, not more than 4%

- Lysolecithin, 50 to 80 mole %of total phosphatides

.

USE

Cosmetic

The ingredients reviewed in this safety assessment function mainly as skin and hair conditioning agents, emulsifying agents, and surfactants in cosmetic products.[6] According to information supplied to the Food and Drug Administration (FDA) by industry as part of the Voluntary Cosmetic Registration Program (VCRP), and the results from a survey of ingredient use concentrations conducted by the Personal Care Products Council (Council) indicate the following phosphoglycerides are being used in cosmetic products at maximum concentrations ranging from 0.00000008% to 50% (lowest and highest values relate to lecithin):[23,24] lecithin, hydrogenated lecithin, lysolecithin, phosphatidylcholine, and phospholipids. The Council survey data also indicate that the highest maximum concentration is 50% for lecithin in a leave-on product. The reported highest maximum use concentrations for other ingredients evaluated in this safety assessment are as follows, all relating to use in leave-on products: lysolecithin (0.2%), phosphatidylcholine (0.8%), and phospholipids (0.75%). Use frequency and concentration of use data are included in Table 3.

According to the CIR final safety assessment on lecithin and hydrogenated lecithin published in 2001, data submitted to FDA in 1984 indicated that the maximum reported use concentration of lecithin was in the 25% to 50% concentration range; use concentration data on hydrogenated lecithin were not included.[1] Concentration of use data provided by the Personal Care Products Council (formerly the Cosmetic, Toiletry, and Fragrance Association [CTFA]) in 1996 indicated that 65% lecithin was used at concentrations of 0.1% to 3%; use concentration data on hydrogenated lecithin were not provided.[1] Data provided by the Council in 2014 indicate use of lecithin at concentrations up to 50%, and, hydrogenated lecithin, at concentrations up to 5%.[24]

Cosmetic products containing phosphoglycerides may be applied to the skin and hair or, incidentally, may come in contact with the eyes and mucous membranes. Products containing these ingredients may be applied as frequently as several times per day and may come in contact with the skin or hair for variable periods following application. Daily or occasional use may extend over many years.

Lecithin is used in perfumes at maximum (max.) concentrations up to 0.0021%, and in hairspray at max. concentrations up to 0.000014% (aerosol) and up to 0.00015% (pump spray), and hydrogenated lecithin is used in pump hair sprays at max. concentrations up to 0.8%. Lecithin is also used in spray deodorants at max. concentrations up to 0.0029% (aerosol) and up to 0.03% (pump spray). Phospholipids are used in aerosol hair spray at max. concentrations up to 0.8%, and lysolecithin, phosphatidylcholine, and hydrogenated lecithin are used in body and hand sprays at max. concentrations up to 0.1%, 0.8%, and 0.65%, respectively. Hydrogenated lecithin is used in moisturizing sprays and face and neck sprays at max. concentrations of 0.65% and 0.5%, respectively. Ingredient use in face powders is also reported for lecithin (up to 1%) and hydrogenated lecithin (up to 0.56%). Because phosphoglycerides are used in products that are sprayed or in powder form, they could possibly be inhaled. In practice, 95% to 99% of the droplets/particles released from cosmetic sprays have aerodynamic equivalent diameters >10 µm, with propellant sprays yielding a greater fraction of droplets/particles below 10 µm, compared with pump sprays.[25,26,27,28] Therefore, most droplets/particles incidentally inhaled from cosmetic sprays would be deposited in the nasopharyngeal and bronchial regions and would not be respirable (i.e., they would not enter the lungs) to any appreciable amount.[25,26] There is some evidence indicating that deodorant spray products can release substantially larger fractions of particulates having aerodynamic equivalent diameters in the range considered to be respirable.[26] However, the information is not sufficient to determine whether significantly greater lung exposures result from the use of deodorant sprays, compared to other cosmetic sprays.

Noncosmetic

Commercial lecithin, defined as a naturally-occurring mixture of the phosphatides of choline, ethanolamine, and inositol, is a direct food substance affirmed as generally recognized as safe (GRAS).[17] Additionally, enzyme-modified lecithin is listed among the substances added directly to human food affirmed as GRAS.[20] The Food Chemicals Codex[29] stipulates that food grade lecithin contain not more than 0.3% hexane-insoluble matter. Because the protein fraction of lecithin would reside in this insoluble material, this specification limits the amount of protein in food grade lecithin to 0.3% or 300 mg/100 grams of lecithin. Food uses of lecithin include: emulsifier, stabilizer, dispersing aid, and release agent for baked goods.[18]

The Food Allergen Labeling and Consumer Protection act (FALCPA) of 2004 altered the way in which lecithin derived from soy must be declared on food labels. Whether intended to have a technical or functional effect in the finished food or to be used as an incidental additive (such as a release agent), lecithin that is derived from soy must be declared as an ingredient, using its common or usual name, and with the food source ("soy," "soya", or "soybeans") declared as required by section 403(w) of the Act.[18]

Lecithin is listed as an inactive ingredient in inhaled (aerosol, metered) drug products that have been approved by FDA.[30]

Phosphatidylcholine is the most abundant phospholipid in mammalian cellular membranes, bile, and lipoproteins.[31] The injection of a phosphatidylcholine and deoxycholic acid preparation is widely used as an alternative to liposuction for the reduction of subcutaneous fat.[32]

TOXICOKINETICS

Non-Human

Lecithin and Lysolecithin

The distribution of intravenously (i.v.) injected 1-^{14}C palmitoyl ^{32}P-lysolecithin was studied using male albino rats.[33] The animals were injected i.v. with 1 ml of rat serum containing endogenously-labeled ^{32}P- lysolecithin or with 1 ml of rat serum containing endogenously-labeled ^{32}P phospholipids. The amount of lysolecithin incorporated into 1 ml of serum ranged between 550 and 850 µg. In some of the experiments, lysolecithin labeled with both ^{32}P and ^{14}C (in fatty acid moiety) was used. At 20 and 60 minutes post-injection, 45% and 77% of injected radioactive material was removed from the blood, respectively. There was an uptake of labeled phospholipids by heart and skeletal muscle. The percentage of ^{32}P lysolecithin in these organs was much higher than in the injected material. The authors noted that the high percentage of labeled lysolecithin in the skeletal and heart muscle indicated that lysolecithin might leave the vascular compartment more rapidly than lecithin and be metabolized by the tissues. The per cent composition of labeled phospholipids found in the liver resembled that of the injected serum, with lecithin as the major labeled component. However, the percentage of lysolecithin was lower than that in the starting material. The authors noted that, based on these results, it seems more likely that the liver takes up phospholipids indiscriminately and that lysolecithin is rapidly converted to lecithin.

In subsequent experiments in which rats were injected with serum containing P^{32} -lysolecithin, the injected labeled lysolecithin disappeared from the blood stream very rapidly ($t_{1/2} \approx 2$ minutes). Considerable amounts of lysolecithin were recovered in the liver and skeletal muscle at a time when the serum radioactivity decreased to negligible levels. The conversion of lysolecithin to lecithin was observed in all the tissues examined, and this reaction was most rapid in the liver. *In vivo*-injected lysolecithin taken up by the liver was converted to lecithin by an acylation reaction.

Phosphatidic Acid

Lysophosphatidic acid was degraded to glycerophosphate and orthophosphate by phosphatidases and phosphatases, respectively, in an enzyme preparation, i.e., cytoplasmic particulate fraction of guinea pig brain or liver.[34]

Phosphatidylserine and Phospholipids

Following i.v. administration to rats and mice, phosphatidylserine was eliminated from plasma in a biphasic manner and largely distributed to several major organs, including the liver spleen, and brain tissue.[35,36,37,38,39] Conversely, orally administered phosphatidylserine was extensively hydrolyzed by phospholipase A_2 to lysophosphatideylserine in the gastrointestinal tract prior to absorption, as is the case for all other dietary phospholipids.[35,40,41] In rats, approximately 60% of an orally administered dose of phosphatidylserine (20 mg/kg body weight) was recovered in the feces, of which 50% was identified as lysophosphatidylserine. Approximately 10% of this orally administered dose was detected in the urine.[38]

Studies in which animals were injected i.v. with phosphatidyl serine also indicate that phospholipids undergo hydrolytic cleavage to the monoacyl derivative lysophosphatidylserine in the plasma, as well as decarboxylation of the serine moiety to phosphatidylethanolamine in circulating blood cells.[36,37,39] Lysophosphatidylserine and phosphatidylethanolamine were also detected in the liver and brain tissues after i.v. administration. However, in all organs, the majority of radioactivity (~90%) was consistently accounted for as unmetabolized phosphatidylserine.[38,39] Conversely, at 60 minutes post oral dosing

of phosphatidylserine (20 mg/kg) in rats, the majority of the circulating plasma radioactivity consisted of phosphatidylserine; the radioactivity at 24 h was primarily due to phosphatidylserine degradation products.[38] Furthermore, less than 20% of the administered dose recovered in the mesenteric lymph of rats after oral administration of phosphatidylserine (560 mg/kg body weight of [^{3}H]-glycerol-labeled, brain-derived phosphatidylserine) was liposoluble, with phospholipids comprising 11% of the liposoluble fraction.[41] The majority of the radioactivity was recovered as triglycerides and, to a smaller extent, diacylglycerol, indicating complete degradation of orally administered phosphatidylserine.

In mammalian cells, phosphatidylserine may undergo decarboxylation to phosphatidylethanolamine in the mitochondria, which is followed by potential re-formation of phosphatidylserine through exchange of the ethanolamine moiety with serine in the endoplasmic reticulum or mitochondria-associated membrane.[42] Thus, in the intestinal absorptive cells, lysophosphatidylserine may be reacylated to yield phosphatidylserine and ultimately converted to phosphatidylethanolamine.[41] Re-esterified phospholipids are subsequently incorporated into intestinal lipoproteins (i.e., chylomicrons) or directly transported as lysophospholipids via the portal system to the liver.[43,44] As the chylomicrons circulate in the blood, their components, including phospholipids, are degraded via lipoprotein lipase hydrolytic activity.[44] Ultimately, the phosphatidylserine degradation products (i.e., free fatty acids, serine, glycerol, and phosphorus-containing substances) enter common physiological pathways of amino acid and lipid metabolism. In turn, intact phospholipids are excreted in the bile, and, thus, may be subject to enterohepatic circulation.

Pharmacokinetic studies indicate exogenous phosphatidylserine crosses the blood-brain barrier, where it appears to have an affinity for the hypothalamus.[45] Oral administration results in peak levels in 1 to 4 h.

Human

In humans, the oral consumption of 5 soy lecithin phosphatidylserine capsules (total of 500 mg phosphatidylserine) resulted in peak plasma phosphatidylserine levels of 3.95% of the total phospholipid plasma concentration, compared to background phosphatidylserine levels of 1.8% to 2.2% of total plasma phospholipids.[21]

Skin Penetration Enhancement

The effects of phosphatidylcholine and hydrogenated phosphatidylcholine on the permeation of indomethacin through hairless rat skin were studied using liquid paraffin and a gel prepared with liquid paraffin and hydrogenated soybean phospholipid.[46] Indomethacin (1%) was mixed with liquid paraffin and PC or HPC, and heated at 95°C for 30 minutes. The mixture was then cooled to room temperature and allowed to stand for 1 day. Skin permeation was measured using a modified Franz-type diffusion cell apparatus. Permeation rates for indomethacin from the liquid paraffin suspension with phosphatidylcholine or hydrogenated phosphatidylcholine were determined. For liquid paraffin without phosphatidylcholine or hydrogenated phosphatidylcholine, permeation of indomethacin was observed only after 10 h. However, within 10 minutes, indomethacin permeated at rates of ~ 10 g/cm^2 and 5 g/cm^2 from liquid paraffin with phosphatidylcholine and hydrogenated phosphatidylcholine, respectively.

The effect of hydrophilic groups of phospholipids on the percutaneous penetration of indomethacin (IM) *in vitro* was examined in a Franz-type diffusion chamber, using dorsal skin from guinea pigs.[47] The following phospholipids were evaluated for enhancement of IM skin penetration: phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylinositol (PI), phosphatidylserine (PS), phosphatidylglycerol (PG), phosphatidic acid (PA) and sphingomyelin (SM). Phospholipid-induced enhancement of IM percutaneous penetration was in the following order: PG > PE > PC > PS > PA > PI > control > SM.

TOXICOLOGY

Single Dose (Acute) Toxicity

Oral

Phosphatidylserine

The oral administration of a purified phospholipid preparation obtained from bovine brain (BC-PS) (in phosphate buffer suspension) to Sprague-Dawley rats (CD strain; number not stated) resulted in an LD_{50} of > 5 g/kg body weight.[48] The test substance (BC-PS) was phosphatidylserine derived specifically from bovine cerebral cortex.

Intravenous

Phosphatidylserine

Following the i.v. dosing of Sprague-Dawley rats (CD strain; number not stated) with BC-PS (in phosphate buffer suspension), an LD_{50} of 236 mg/kg body weight was reported.[48]

Subcutaneous

Phosphatidylserine

When Sprague-Dawley rats (CD strain; number not stated) were dosed subcutaneously (s.c.) with BC-PS (in phosphate buffer suspension), an LD_{50} > 5 g/kg body weight was reported.[48]

Repeated Dose Toxicity

Inhalation

Phosphatidylcholine

The effects of chronic exposure to liposome aerosols on lung histology and alveolar macrophage function were studied.[49] Liposomes were made from hydrogenated soy phosphatidylcholine (HSPC at 50 mg/mL). Groups of 30 mice (strain not stated) were placed in a nose-only exposure module and exposed to liposome (20 ml total volume, 50 mg lipid/mL phosphate-buffered saline) or saline aerosols 1 h per day, 5 days per week, for 4 weeks. Five mice of both the experimental and control groups were removed weekly and their lungs examined. The animals were killed and bronchoalveolar lavage (BAL) was performed through a tracheostomy. *In vivo* uptake of liposomes by alveolar macrophages was documented by fluorescence microscopy and flow cytometry of BAL. A consistent amount of 1 to 3 µg of lipid inhaled per dosing per mouse was estimated from fluorescence measurements. No histologic changes of the lungs or untoward effects on general health or survival of animals were noted. Alveolar macrophage phagocytic function was not affected. Transmission electron microscopy and morphometry showed no treatment-related alterations.

Oral

Non-Human

Lecithin

A group of 48 male and 48 female SPF Wistar rats was fed 4% (soya) lecithin for 2 years, while a control group was fed commercial diet only.[50] Feed consumption and body weights were determined prior to dosing, at intervals up to week 95, at week 102, and at study termination. The mean lecithin intake was 1470 and 2280 mg/kg/day for males and females, respectively. No significant differences were observed for mortality, feed consumption, or body weight between the treated and control groups, but it was noted that feed consumption and body weight were sometimes greater in the treated group as compared to controls. Hematology values of animals of the treated group were similar to those of control animals, as were organ weights and gross and microscopic alterations. Increased parathyroid gland hyperplasia, particularly in the males, was attributed to an increased phosphate intake. The incidence of tumor formation was similar for the treated and control groups. A slightly increased incidence of myocardial fibrosis was associated with parathyroid gland hyperplasia.

Lecithin, Phosphatidylserine, Phosphatidylcholine, Phosphatidylethanolamine, Phosphatidylinositol, and Phosphatidic Acid

A 90-day feeding study was performed to evaluate the safety of dietary soy lecithin transphosphatidylated phosphatidylserine (SB-PS), with or without fish oil-derived long-chain polyunsaturated fatty acids (LC-PUFA) mixed or conjugated to the glyceride backbone.[51] One-hundred-two male Wistar rats (wild type, pathogen free) were randomly assigned to 6 groups. The 5 treatment groups consumed normal chow containing each of the following components (100 mg), respectively, incorporated in 1 ml of milk-based supplement matrix:

- medium-chain triglycerides (MCT) (MCT group)
- fish oil diluted with MCT to yield 30% (w/w) of omega-3 LC-PUFA (omega-3 group)
- soybean 78% powdered soy lecithin transphosphatidylated PS (final concentration of 20% SB-PS (w/w)) emulsified with 13% phosphatidylcholine (PC), 2% phosphatidylethanolamine (PE), 1% phosphatidylinositol (PI), 4% phosphatidic acid (PA) and further diluted with MCT (SB-PS group)
- fish oil mixed with soybean 78% powdered soy lecithin transphosphatidylated PS and diluted with MCT to yield a final concentration of 20% SB-PS (w/w) and 30% (w/w) of omega-3 LC-PUFA (omega-PS group)
- 20% PS (w/w) consisting largely of molecular species of palmitic acid (16:0) and docosahexanoic acid (22:6) or eicosapentanoic acid (20:5), resulting in 30% (w/w) of omega-3 LC-0PUFA (PS-DHA group).

The control group consumed normal chow. Blood samples were drawn and hematological parameters evaluated. Signs of toxicity were not observed during the feeding period. At the end of the study, gross examination of organs was performed. The following mortalities were reported: 1 rat (control group), 2 rats (MCT group), 1 rat (omega-3 group), and 1 rat (PS-DHA group). Pathological examinations did not reveal a specific cause of death; however it was concluded that the deaths were not treatment-related. Hematological parameters were normal in all treatment groups. At gross pathological examination, there were mild signs of liver enlargement in 5 of 102 rats, and these were considered unrelated to treatment. Possible early signs of lung metastasis (pale color nodes and different tissue consistency) were observed in 4 of 102 rats, but these findings were considered typical and abundant in rats of this age (15 months old). It was noted that none of these pathological findings occurred in PS-fed rats. There were additional macroscopic findings in treatment groups. It was concluded that no adverse effects were associated with diets fed in this study.

Phosphatidylserine

The repeated dose toxicity of BC-PS (in phosphate buffer suspension) was studied using 3 groups of Sprague-Dawley rats of the CD strain (20 males, 20 females/group).[48] The 3 groups received doses of 10, 100, and 1,000 mg/kg/day, respectively, by gavage daily for 26 weeks. The control group was dosed with phosphate buffer only. Body weight gain and food consumption in all dose groups were comparable to the control group. No significant hematological changes were observed. At week 13, slightly elevated alkaline phosphatase levels in male and female rats, and slightly lowered serum albumin levels in males was observed in the 1,000 mg/kg/day dose group. Elevated potassium and lower sodium values were reported for males at week 13. Terminal studies indicated no major problems, and there were no significant morphological changes. It was concluded that BC-PS did not cause significant toxicity in this study.

Another repeated dose toxicity study involved groups of 40 beagle dogs (20 males, 20 females).[48] Three groups received BC-PS (in corn oil) orally at doses of 10, 100, and 1,000 mg/kg/day (dose volume = 5 ml/kg), respectively, for 1 year. The control group was dosed with corn oil. None of the animals died. At the highest dose administered, blood glucose and cholesterol levels were significantly lowered. There were no significant macroscopic findings, and organ weights were within normal range. Histopathological examination of tissues did not indicate treatment-related changes. It was concluded that BC-PS did not cause significant toxicity in this study.

Human

Phosphatidylserine

Test groups (humans) received soy lecithin-derived phosphatidylserine (300 or 600 mg) daily in a 12-week study.[52] There were no clinically-significant variations in blood chemistry or hematology. Additionally, there were no differences in the occurrence of side effects between test and placebo groups.

Intravenous

Phosphatidylserine

BC-PS (in phosphate buffer suspension) was administered i.v. to groups of Sprague-Dawley rats of the CD strain (10 males, 10 females/group).[48] The 3 groups received doses of 5, 20, and 80 mg/kg/day (dose volume = 2.5 ml/kg), respectively, daily for 4 weeks. The control group was dosed with vehicle only. Except for females of the 5 mg/kg/day group, reddening and swelling of the paws and around the muscle region were observed in all dose groups. The following hematological changes were observed in male and female rats of the 80 mg/kg dose group: significant lowering of the erythrocyte count, hemoglobin concentration, and packed cell volume, and increased neutrophil and lymphocyte counts. An

increase in spleen weight in males and females of the 80 mg/kg dose group and males of the 20 mg/kg dose group was reported. Kidney weights of males dosed with 80 or 20 mg/kg were also increased when compared to controls. Adrenal weights of males and females of the 80 mg/kg dose group were marginally increased. Results at microscopic examination revealed an injection site thrombosis in some rats in all dose groups, with an increase in severity in rats dosed with 20 mg/kg or 80 mg/kg. Whether or not this finding was reported for the control group was not stated. An increase in the incidence of extramedullary hematopoiesis was observed in the 80 mg/kg dose group. It was concluded that BC-PS did not cause significant toxicity in this study.

The i.v. toxicity of BC-PS (in phosphate buffer suspension) was evaluated using groups of 24 (12 males, 12 females) Beagle dogs.[48] Three groups were injected i.v. with BC-PS at doses of 5, 15, and 40 mg/kg/day, respectively, for 4 weeks. A fourth group was dosed with vehicle only. Generalized tremors of body muscles were observed in animals of the 15 or 40 mg/kg/day group. A significant increase in total white cell count and a reduction in total serum protein values were reported for dogs dosed with 40 mg/kg/day. At gross examination, hemorrhage was observed around the injection sites. There were no significant group differences in organ weights. Microscopic examination of the liver revealed centrilobular and periportal sinusoidal aggregations of polymorphonuclear leukocytes in one animal of the 15/mg/kg/day dose group and in 4 animals of the 40 mg/kg/day dose group. It was concluded that BC-PS did not cause significant toxicity in this study.

Intramuscular

Phosphatidylserine

The intramuscular toxicity of BC-PS (in phosphate buffer suspension) was evaluated using groups of 32 (16 males, 16 females) Beagle dogs.[48] Three groups were injected intramuscularly with BC-PS at doses of 5, 10, and 15 mg/kg/day, respectively, for 6 weeks. A fourth group served as the vehicle control. None of the animals died. Subcutaneous hardening and/or swelling of injection sites was observed in the 10 and 15 mg/kg/day dose groups. Hematological analyses indicated elevation of the erythrocyte sedimentation rate and an increase in total white blood cell count in the 15 mg/kg dose group. At gross examination, subcutaneous hemorrhage and adhesion between the skin and muscles (at injection site) was reported for all groups, including the control group. This finding was considered dose-related. Organ weights were within normal ranges. Muscle degeneration, and subcutaneous and intramuscular acute inflammatory cell infiltration and necrosis were also observed at injection sites. It was concluded that BCV-PS did not cause significant toxicity, i.e., there were no significant signs of systemic toxicity.

Cytotoxicity

Lysolecithin

Lysolecithin has been described as a powerful hemolytic and cytolytic phosphoglyceride.[53,54] Furthermore, the toxic effect of many snake venoms is attributable to their content of phosphatidase A, an enzyme capable of converting plasma phosphatides into lysophosphatides, one of which is lysolecithin.

Neurotoxicity

Lysophosphatidic Acid, Lysophosphatidylglycerol, and Lysophosphatidylethanolamine

Lysophosphatidylcholine rapidly paralyzes the neuromuscular junction (NMJ) in a manner that is similar to snake phospholipase A2 neurotoxins. A study was performed to investigate NMJ paralysis in the presence of different lysophospholipids tested at 150 µM in a nerve-muscle preparation.[55] Mouse phrenic nerve hemidiaphragms were isolated from CD-1 mice, and the phrenic nerve was stimulated using two ring platinum electrodes. Muscle contractions were monitored using an isometric transducer. Results indicated the following order of potency in causing NMJ paralysis: lysophosphatidylcholine > lysophosphatidylethanolamine > lysophosphatidic acid > lysophosphatidylserine > lysophosphatidylglycerol. Paralysis was fully reversed by washing the phrenic nerve hemidiaphragms with a bovine albumin.

Ocular Irritation

Lecithin

Lecithin 65% (solution of 65% lecithin) and products containing 2.25% or 3.0% Lecithin 65% were non- to minimally irritating to unrinsed rabbit eyes. A soap containing 0.83% lecithin powder (tested at 25%) was moderately irritating, and lecithin-containing liposomes were practically nonirritating in a Draize test.[1]

Skin Irritation and Skin Sensitization

Non-Human

Lecithin and Hydrogenated Lecithin

In single-insult occlusive patch tests (rabbits), lecithin 65% (solution of 65% lecithin) was minimally irritating, products containing 3% lecithin 65% were practically non- to mildly irritating, and a product containing 2.25% lecithin 65% was non-irritating to the skin of rabbits. In a guinea pig immersion study, 0.5% of a soap containing 0.83% lecithin powder was practically non-irritating. Hydrogenated lecithin was not a primary dermal irritant in rabbits.[1]

Human

Lecithin and Hydrogenated Lecithin

In clinical irritation studies, cosmetic formulations containing 0.3% or 3% lecithin 65% (solution of 65% lecithin), a soap containing 0.83% lecithin powder (tested at 0.5%), and lecithin liposomes were generally non-irritating. Barely perceptible erythema was the most severe reaction observed. Hydrogenated lecithin also was not an irritant, and hydrogenated lecithin (15% in petrolatum) was not a sensitizer. Additionally, a tanning oil containing 3% lecithin 65%, a mascara containing 0.1% lecithin 65%, and a foundation containing 0.3% lecithin 65% were non-sensitizing.[1]

Allergenicity

Lecithin

The antigenicity of soy lecithin was studied using 30 soybean-sensitive patients.[19] The IgE- and IgG4-binding activities of the soy lecithin proteins were evaluated by immunoblotting with sera obtained from the patients, 7 of whom had a positive challenge test. In 100 grams of sample, the soy lecithin contained 2.8 mg of proteins. The proteins present in soy lecithin were analyzed by sodium dodecyl sulfate (SDS) polyacrylamide gel elelectrophoresis (PAGE). In the soy lecithin, the detection rate of only one protein (molecular weight: 31 kDa) by the serum IgE of patients was significantly different when compared to controls (detection rate: 40%). Proteins in the molecular weight range of 58 to 67 kDa were rarely bound to serum IgE. Only one of the patients with a positive challenge test had IgE antibodies to soy lecithin proteins. The presence of IgG4-binding proteins in soy lecithin was described as rare. It was concluded that the proteins present in soy lecithin have little antigenicity with respect to soybean allergy.

Photocytotoxicity

Non-Human

Hydrogenated Lecithin

The photocytotoxicity of liposome-fullerene (Lpsm-Flln, 0.2% aqueous) was studied using Balb/3T3 fibroblastic cells.[56] Bacterial assay results for this liposome are included in the Genotoxicity section. Lpsm-Flln had the following composition: hydrogenated lecithin, glycine soja (soybean) sterols, and fullerene C60 (C60) in the weight ratio of 89.7:10:0.3 (i.e., contains 89.7% hydrogenated lecithin). Results were compared with that of a 0.2% liposome solution (Lpsm) that did not contain C60, described as follows: hydrogenated lecithin and glycine soja (soybean) sterols in the weight ratio of 90:10 (i.e., contains 90% hydrogenated lecithin). The fibroblasts (in Lpsm-Flln or Lpsm at doses of 0.49 to 1,000 µg/mL) were exposed to sham-irradiation or UVA light (5 J/cm^2, 320–400 nm, λ_{max} = 360 nm) for 50 minutes. Cell viability of Balb/3T3 fibroblastic cells in Lpsm-Flln was 96.3 - 158.5% for the UVA group and 94.5 - 149.6% for the sham group, and did not decrease dose-dependently. Also, cell viability in Lpsm was similar to that in Lpsm-Flln. These results show that Lpsm-Flln (89.7% hydrogenated lecithin) or Lpsm (90% hydrogenated lecithin) at a concentration of 0.2% was not photocytotoxic to Balb/3T3 fibroblasts.

Phototoxicity/Photosensitization

Lecithin and Hydrogenated Lecithin

A foundation containing 0.3% lecithin 65% (solution of 65% lecithin) was not a photosensitizer. Lecithin and hydrogenated lecithin (both at 15% in petrolatum) were not phototoxic or photosensitizing.[1]

Case Reports

Lecithin

A 3-year-old boy with a history of asthma and peanut allergy was treated for asthma that developed after an upper respiratory tract infection.[57] He developed respiratory distress and generalized urticaria within an hour after receiving the second of 2 inhalations of an ipratropium bromide inhaler. All signs regressed within 48 h of withdrawal of the drug. Soy lecithin, an excipient in the metered dose inhaler, was strongly suspected of causing the adverse events.

Lysolecithin

The intracutaneous injection of 0.04 µM to 0.25 µM lysolecithin, derived from beef serum, human serum, or beef brain lecithin, caused typical wheal and erythema reactions in the 3 subjects tested.[58] Lysolecithin (0.125 and 0.17 µM) produced wheal and erythema reactions that were roughly equivalent to that produced by the injection of histamine (0.5 µg). These reactions consisted of a pale, elevated central swelling (occasionally with small pseudopods), surrounded by a bright red zone of erythema. The lower concentrations of lysolecithin (0.085 and 0.043 µM) caused minor reactions that were smaller than those obtained with 0.3 µg histamine, but slightly greater than those caused by 0.1 µg histamine (slight threshold reaction). A faint, but definite, reaction was observed at concentrations as low as 0.013 µM in another experiment.

REPRODUCTIVE AND DEVELOPMENTAL TOXICITY

Phosphatidylserine

In a teratogenicity study, BC-PS was administered orally (by gavage) to pregnant Sprague-Dawley rats (CD strain) at daily doses of 0, 10, 100, and 200 mg/kg/day on days 6 through 18 of gestation.[48] The animals were killed at day 20 of gestation, and litters were examined for skeletal and visceral abnormalities. At terminal necropsy, there were no treatment-related gross changes. Additionally, the following litter values were not affected by treatment with BC-PS: litter size, post-implantation loss, litter and mean fetal weights, and embryonic and fetal development.

BC-PS was also administered orally (by gavage) to pregnant New Zealand White rabbits at daily doses of 0, 50, 150, and 450 mg/kg/day on days 6 through 18 of gestation.[48] On gestation day 29, the animals were killed and litters subjected to gross examination. Fetuses were examined externally and internally for evidence of visceral and skeletal malformations. There was no evidence of systemic effect, and neither pregnancy nor mortality was affected by treatment. At the highest dose, mean fetal weights were slightly lower when compared to control values, but the difference was not statistically significant. Additionally, there were no treatment-related effects on embryonic and fetal development.

Lysophosphatidic Acid

Lysophosphatidic acid and sphingosine 1-phosphate (S1P) are both lysophospholipids.[59] Because lysophosphatidic acid promotes prostaglandin synthesis, mediators in the lysophosphatidic acid pathway may also play a significant role in implantation and parturition. Sphingosine 1-phosphate signaling is thought to be essential in vascular formation within the uteroplacental unit and in fetomaternal immunologic interactions. Derangements in either one of these lysophospholipid

signaling pathways could result in pregnancy complications that may include implantation failure, preeclampsia, and preterm labor.

Immature germinal vesicle (GV) stage oocytes from 5- to 6-week-old female BDF-1 mice were incubated for 17–18 h in *in vitro* maturation (IVM) medium containing 0, 1, 10 or 30 µM lysophosphatidic acid and then either fertilized *in vitro* with epididymal sperm or assessed for spindle morphology or mitochondrial membrane potential.[60] Chromosomal aneuploidy in the resultant blastocysts and the production of normal pups were not assessed. The fertilized embryos were grown in *vitro* to assess blastocyst-formation rates, differential cell counts and apoptosis. The supplementation of IVM with 30 µM lysophosphatidic acid enhanced the maturation and developmental competence of BDF-1 mouse oocytes. Rates of maturation, fertilization and blastocyst formation and hatching were significantly higher in the 30 µM lysophosphatidic acid-supplemented group (94.3%, 96.3%, 79.1 and 51.3%, respectively) than in the unsupplemented control (0 mM) group (80.5%, 87.5%, 61.3% and 37.8%, respectively), and more comparable to that of the *in vivo* matured oocytes (100%, 96.5%, 95.3% and 92.9%, respectively). Lysophosphatidic acid did not adversely affect mitochondrial activity, spindle integrity, or blastocyst cell number. The results of this study imply that the supplementation of IVM medium with 30 µM lysophosphatidic acid may enhance the developmental competence of mouse oocytes without affecting apoptosis, spindle normalcy or mitochondrial integrity.

GENOTOXICITY

Bacterial Cells

Hydrogenated Lecithin

The genotoxicity of Lpsm-Flln or Lpsm (313–5000 µg/plate) was examined, with and without metabolic activation, using *Salmonella typhimurium* strains TA98, TA100, TA1535, and TA1537 and *Escherichia coli* strain WP2uvrA (pKM101).[56] Neither liposome was genotoxic in this assay, with or without metabolic activation. The following 5 positive controls were genotoxic: sodium azide, *N*-ethyl-*N*'-nitro-*N*-nitrosoguanidine, 2-nitrofluorene, 9-aminoacridine, and 2-aminoanthracene.

Mammalian Cells

Phosphatidylserine

Human lymphocyte cultures were incubated with BC-PS concentrations up to 165.6 µg/ml, with and without metabolic activation.[48] Cyclophosphamide served as the positive control. BC-PS was not genotoxic with or without metabolic activation.

In the mouse lymphoma assay, BC-PS was not genotoxic to mouse lymphoma L5178Y cells with or without metabolic activation.[48] Test concentrations were not stated.

BC-PS was evaluated in a DNA repair assay involving human epithelioid cells (HELA S_3 cells), with and without metabolic activation.[48] Test concentrations were not stated. Increases in the number of silver grains found over cell nuclei served as indicators of repair synthesis. There was no evidence of DNA repair synthesis with or without metabolic activation.

In the micronucleus test, BC-PS was administered orally (by gavage) to mice at doses up to 300 mg/kg body weight.[48] Two equal doses were administered, separated by a 24-h interval. Mitomycin C served as the positive control. Bone marrow smears were examined for the presence of micronuclei in 1,000 polychromatic erythrocytes per mouse, and for the ratio of normochromatic to polychromatic erythrocytes. BC-PS was neither cytotoxic nor genotoxic to bone marrow cells.

Modulation of Gene Expression

Phospholipids

The capacity of a formulation of grape seed extract and soy phospholipids (formulation identified as SBD.5HC) to trigger a regenerative response in the dermis and epidermis through a selective action on the hypodermis was investigated using human skin (from breast reduction surgical waste).[61] SBD.5HC was prepared by combining grape seed extract (95%

proanthocyanidins-grade) and soy lecithin (95% - 98% phospholipids-grade) at a ratio of 1:3 w/w. After 5 days of culture under control conditions, full-thickness human skin biopsies showed marked degradation, characterized by pyknotic nuclei in fibroblasts and basal keratinocytes, as well as intercellular gaps in spiny and granular layers of the epidermis. The inclusion of SBD.5HC (100 µg/ml) in the medium bathing the hypodermal layer of the biopsies resulted in an improved overall morphology. Treated skin samples had mostly normal, elongated fibroblasts, a decreased number of dying basal keratinocytes at the dermal-epidermal junction, less gaping spaces in the stratum spinosum, and better preserved granulosum and stratum corneum. Thus, study results indicated that the application of SBD.5HC to the hypodermal layer of skin triggered modulation of gene expression in the upper layers of skin, and resulted in morphological changes in the dermis and epidermis.

CARCINOGENICITY

Lecithin

TM strain mice were fed 5 to 10 mg lecithin mixed with sugar (for palatability), and a second group was fed lecithin (5 to 10 mg) and cholesterol (4 to 5 mg).[62] The mice were bred and their offspring dosed following the same procedures; dosing continued until all mice became moribund or had died. A control group was given laboratory feed *ad libitum*. The total number of mice fed lecithin, lecithin and cholesterol, or control feed was 166, 212, and 360, respectively. The brains of animals, moribund or found dead, were removed and necropsied (results not reported). Brain nerve cell tumors (2-5 mm) were found in 18 of 73 examined animals fed lecithin and in 27 of 88 examined animals fed lecithin and cholesterol, whereas, no brain nerve cell tumors were found in 188 control animals.

Groups of female dd mice were dosed s.c. as follows: Fifty mice were given 0.1 ml of a 0.25% mixture of 4-nitroquinoline1-oxide (in 10% aqueous lecithin) in a single injection until the total dose was 2.5 mg.[63] The injections were repeated weekly, each time in a different site on the back. Thirty mice were dosed (10 times) with a lecithin-water mixture at the same total dose as in the previous group. Twenty mice were not dosed and served as controls. The mice were killed after 221 to 296 days. Animals dosed with 4-nitroquinoline 1-oxide/lecithin that survived more than 221 days after dose initiation (36/50) had pulmonary neoplasms; skin neoplasia at the injection site (1 animal) and leukemia (1 animal) were also observed in this group. No surviving mice dosed with lecithin-water or untreated control mice had pulmonary or any other type of neoplasia. However 3/28 animals of the lecithin-water group and 3/18 control animals had adenomas; these were considered spontaneous.

In the same study, groups of female Buffalo rats were dosed s.c. as follows: Twenty-five rats were given 0.2 ml of a 0.25% mixture of 4-nitroquinoline 1-oxide (in 10% aqueous lecithin) in a single injection until the dose reached 10 mg; the injections were repeated weekly. Fifteen rats were dosed (20 times) with a lecithin-water mixture, having received the same total dose. The rats were killed after 264 to 329 days. Nineteen of the 25 animals dosed with 4-nitroquinoline 1-oxide/lecithin that survived more than 264 days after dose initiation had pulmonary neoplasms, with 11 s.c. sarcomas and 2 endometrial sarcomas also reported. No neoplasms were found in any of the 13/15 surviving rats dosed with lecithin-water.[63]

Epidemiology

Phospholipids

A case-cohort analysis was performed using a random sample of 1,717 men, in which 464 prostate cancer cases were reported.[64] The purpose of the analysis was to investigate associations between fatty acids assessed in plasma phospholipids (PPLs) or diet and prostate cancer risk. The subcohort included a random sample of 1,784 men, 59 of whom were also cases. Thus, the analyses included 1,717 men in the subcohort and 464 men with prostate cancer (56 of whom were in the subcohort), including 127 with aggressive tumors. Fatty acids in the diet were estimated using a 121-item food frequency questionnaire. Hazard ratios (HR) and 95% confidence intervals were estimated using Cox regression. Prostate cancer risk was positively associated with % PPL saturated fatty acids (SFAs). HRs were statistically significantly elevated for % PPL palmitic acid; % PPL oleic acid was inversely associated with risk. Dietary intake observations did not reveal any statistically significant linear trends. The HRs were elevated for moderate intakes of linoleic acid, but the increase was not significant for higher intakes. Thus, the authors reported a positive linear association between %PPL SFA and prostate cancer risk, a nonlinear relationship for %PPL palmitic acid and weak evidence of an inverse monotonic association for %PPL monounsaturated fatty acid, primarily because of oleic acid. Higher prostate cancer risks were also observed for dietary n-6 polyunsaturated fats, primarily linoleic acid.

Phospholipid Accumulation During Malignancy

Phosphatidylcholine

Phosphatidylcholine is the most prominent type of phospholipid that has been found in both malignant and control tissues, and the mechanism for its accumulation during malignancy was investigated.[65] Decreases in phospholipase C and D activities were observed in human colonic tumor samples, but enhancement of the cytidine 5' triphosphate (CTP):phosphocholine cytidylyltransferase activity was also detected. Immunoblotting analysis showed that the elevated cytidylyltransferase activity was caused by a three-fold increase in the level of enzyme protein during tumor development. Based on these enzyme studies, it was concluded that the high level of phosphatidylcholine in colon tumors was caused by a decrease in its turnover and an increase in its expression.

Carcinogenicity Mechanisms

Phospholipids

Lipids are essential for many biologic functions, including energy production, signaling, and cell growth and division. Defects in lipid metabolism are associated with several diseases, among which atherosclerosis, hypertension, obesity, diabetes, and cancer are the most important. According to a review article on ovarian cancer, higher intake of dietary lipids, systemic lipid metabolism malfunction, and abnormal serum lipid levels are related to ovarian cancer. The overexpression of some lipid metabolic enzymes are also found in ovarian cancer.[66] Furthermore, alterations of choline phospholipid metabolism have been reported in ovarian cancer.[67]

Lysophosphatidic Acid

Lysophosphatidic acid is a major mitogen in serum that regulates an array of cellular processes that are related to the pathogenesis of cancer, especially ovarian, prostate, and breast cancers.[68] It is a ligand of three G protein-coupled cell surface receptors. Prostate cancer cells express these lysophosphatidic receptors, and it has been suggested that their expression correlates with more advanced prostate cancer. Androgen markedly upregulates the expression of lysophosphatidic acid receptor 3 (LPA-3) in the human prostate cancer LNCaP cell line. LNCaP cells are androgen-responsive prostate cancer cells, making them similar to early stage carcinoma. In a study using protein/DNA array analyses of lysophosphatidic acid-stimulated HeyA8 cells in which the expression of $G\alpha_{12}$ was silenced, it was demonstrated that $G\alpha_{12}$-dependent mitogen signaling by lysophosphatidic acid involves the atypical activation cAMP-response element binding protein (CREB).[69] Furthermore, the results of this study indicated that CREB is a critical signaling node in lysophosphatidic acid-/lysophosphatidic acid receptor-/$G\alpha_{12}$/*gep* proto-oncogene-stimulated oncogenic signaling in ovarian cancer cells. Cell motility is one of the important properties in the progression of cancer cells, and it has been demonstrated that lysophosphatidic acid receptors have diverse effects on the cell motile activities of cancer cells.[70]

Lysophosphatidic acid has also been identified as a novel "ovarian cancer activating factor", a growth factor that is present in ascetic fluid samples from ovarian cancer patients.[71,72] This has led to the characterization of lysophosphatidic acid as a potential biomarker for ovarian cancers.[69] Functional roles of lysophosphatidic acid are driven by extracellular signaling through at least six 7-transmembrane (a.k.a. G protein-coupled 4) receptors.[73] These receptors, named LPA_{1-6}, signal through numerous effector pathways activated by heterotrimeric G proteins, including $G_{i/o}$, $G_{12/13}$, G_q, and G_s.

OTHER STUDIES

Skin Composition

Lecithin, Lysolecithin, Phosphatidylethanolamine, and Phosphatidylserine

Non-Human

Lecithin, phosphatidylethanolamine, and phosphatidylserine comprise the major phospholipid components of skin from young adult female albino rabbits.[74] Polyglycerolphosphatides, lysolecithin, and sphingomyelin are also present.

Human

In a study in which the total lipid concentration, distribution of all major lipid species, and the fatty acid composition in human stratum corneum were assessed, the following lipids were found: phospholipids (phosphatidylethanolamine), cholesterol sulfate, neutral lipids (free sterols, free fatty acids, triglycerides, sterol and wax esters, squalene, and n-alkanes), and sphingolipids.[75] The neutral lipids contributed the greatest proportion to the stratum corneum lipids.

Biosynthesis

Phosphatidylglycerol

Enzymes present in cell-free extracts of liver and other animal tissues catalyze the synthesis of phosphatidylglycerol according to the following equations:[76]

cytidine diphosphate(CDP)-diglyceride + L-α-glycerophosphate → phosphatidylglycerophosphate + CMP

Phosphatidylglycerophosphate → phosphatidylglycerol + orthophosphate

Phosphatidic Acid

A chemically synthesized lysophosphatidic acid was acylated by *S*-palmityl coenzyme A to form phosphatidic acid in the presence of a cytoplasmic particulate fraction of guinea pig brain or liver.[34]

Effect on Immune Response

BALB/cAnN mcie were immunized by injection with 150 µl of an emulsion containing ovalbumin (50 µg) or 150 µg of Keyhole limpet hemocyanin (KLH) in complete Freund adjuvant (CFA). After s.c. injection of phosphatidylserine liposomes (dose = 25 mg/kg body weight) into mice, inhibition of the adaptive immune response after immunization was observed and described as follows:[77] reductions in the draining of lymph node tissue mass (accompanied by reduced numbers of total leukocytes and antigen-specific $CD4^+$ T cells), decreased formation and size of spleen and lymph node germinal centers, and decreased blood levels of antigen-specific IgG.

SUMMARY

The safety of the following 17 ingredients in cosmetics is reviewed in thissafety assessment: lecithin, hydrogenated lecithin, lysolecithin, hydrogenated lysolecithin, phospholipids, hydrolyzed phospholipids, phosphatidic acid, lysophosphatidic acid, phosphatidylglycerol, lysophosphatidylglycerol, phosphatidylserine, ammonium phosphatidyl rapeseedate, phosphatidylcholine, hydrogenated phosphatidylcholine, hydrogenated lysophosphatidylcholine, lysophosphatidylethanolamine, and phosphatidylinositol. These ingredients function mainly as skin and hair conditioning agents, emulsifying agents and surfactants in cosmetic products. Frequency of use data from FDA and the results of an industry survey indicate that the following ingredients are being used in cosmetic products: lecithin, hydrogenated lecithin, lysolecithin, phosphatidylcholine, and phospholipids. Of these ingredients, the highest maximum concentration is 50% for lecithin in a leave-on product.

The fate of i.v.-injected 1-^{14}C palmitoyl ^{32}P-lysolecithin was studied using male albino rats. A high percentage of labeled lysolecithin was detected in skeletal and heart muscle, and it is likely that that lysolecithin is rapidly converted to lecithin in the liver. Following i.v. administration to rats and mice, phosphatidylserine was eliminated from plasma in a biphasic manner and largely distributed to several major organs, including the liver spleen, and brain tissue. In rats, approximately 60% of an orally administered dose of phosphatidylserine (20 mg/kg body weight) was recovered in the feces, of which 50% was identified as lysophosphatidylserine. Approximately 10% of this orally administered dose was detected in the urine. In humans, the oral consumption of soy lecithin phosphatidylserine capsules (total of 500 mg phosphatidylserine)

resulted in peak plasma phosphatidylserine levels of 3.95% of the total phospholipid plasma concentration, when compared to background phosphatidylserine levels of 1.8% to 2.2% of total plasma phospholipids.

The effect of the following phospholipids on the percutaneous penetration of indomethacin (IM) was evaluated *in vitro* using dorsal skin from guinea pigs: phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylinositol (PI), phosphatidylserine (PS), phosphatidylglycerol (PG), phosphatidic acid (PA) and sphingomyelin (SM). Phospholipid-induced enhancement of IM percutaneous penetration was in the following order: PG > PE > PC > PS > PA > PI > control > SM.

In a study in which a purified phospholipid preparation obtained from bovine brain (BC-PS, in phosphate buffer suspension) was administered orally to Sprague-Dawley rats indicated that the LD_{50} is > 5 g/kg body weight was reported.

In a repeated dose inhalation toxicity study involving mice exposed to phosphatidylcholine liposomes, no histologic changes of the lungs or untoward effects on general health or survival of animals were noted. In a two-year feeding study on 4% lecithin involving rats, no significant differences were observed for mortality, feed consumption, or body weight between the treated and control groups. Additionally, there were no differences in gross or microscopic findings when the groups were compared.

In a 12-week study in which human subjects received soy lecithin-derived phosphatidylserine daily, there were no clinically-significant variations in blood chemistry or hematology. Additionally, there were no differences in the occurrence of side effects between test and placebo groups.

Lecithin 65% (solution of 65% lecithin) and products containing 2.25% or 3.0% Lecithin 65% were non- to minimally irritating to unrinsed rabbit eyes. In single-insult occlusive patch tests (rabbits), lecithin 65% was minimally irritating, products containing 3% lecithin 65% were practically non- to mildly irritating, and a product containing 2.25% lecithin 65% was non-irritating to the skin of rabbits.

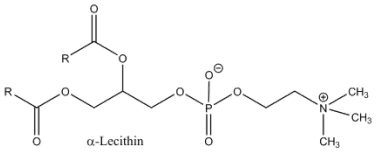
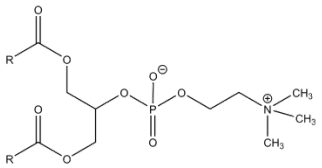
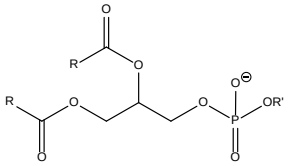
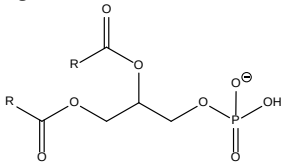
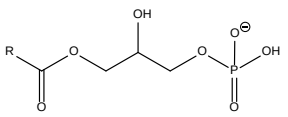
The photocytotoxicity of liposome-fullerene (Lpsm-Flln, 0.2% aqueous) was studied using Balb/3T3 fibroblastic cells; results were negative. A foundation containing 0.3% lecithin 65% (solution of 65% lecithin) was not a photosensitizer. Lecithin and hydrogenated lecithin (both at 15% in petrolatum) were not phototoxic or photosensitizing.

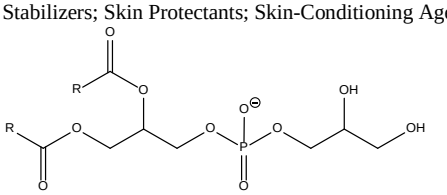
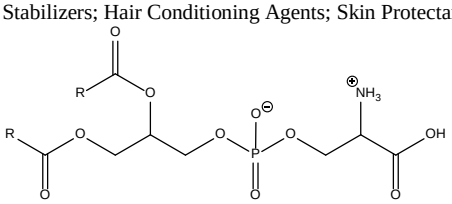
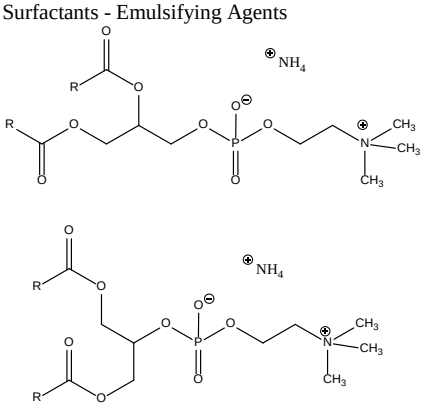
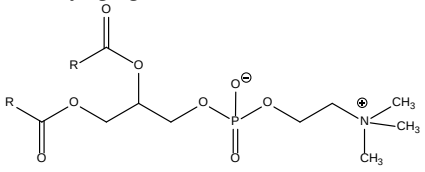
In oral teratogenicity studies on BC-PS involving rats and rabbits, there were no treatment-related effects on embryonic and fetal development. Lysophosphatidic acid (30 µM) enhanced the maturation and developmental competence of BDF-1 mouse oocytes *in vitro*.

Hydrogenated lecithin was not genotoxic to *Salmonella typhimurium* or *Escherichia coli* bacterial strains with or without metabolic activation. The results for phosphatidylserine in mammalian cell assays (i.e., mouse lymphoma, DNA repair [HELA cells], micronucleus assays) were also negative.

TM strain mice were fed 5 to 10 mg lecithin mixed with sugar, and a second group was fed lecithin and 4 to 5 mg cholesterol. Brain nerve cell tumors (2-5 mm) were found in 18 of 73 examined animals fed lecithin and in 27 of 88 examined animals fed lecithin and cholesterol; brain nerve cell tumors were not found in 188 control animals. In another study, groups of female dd mice were dosed s.c. with a 0.25% mixture of 4-nitroquinoline1-oxide (in 10% aqueous lecithin). No surviving mice dosed with lecithin-water or untreated control mice had pulmonary or any other type of neoplasia. However, 3/28 animals of the lecithin-water group and 3/18 control animals had adenomas, which were considered spontaneous.

Table 1. Names, CAS Registry Numbers, Structures, and Definitions of the Phosphoglyceride Ingredients (INCI Dictionary; Staff)[6]

Ingredient & CAS No.	Definitions, Structures, and Functions
Lecithin 8002-43-5 8030-76-0 93685-90-6	Lecithin is a naturally occurring mixture of the diglycerides of stearic, palmitic and oleic acids, linked to the choline ester of phosphoric acid. It is found in living plants and animals. **Functions:** Skin-Conditioning Agents - Miscellaneous; Surfactants - Emulsifying Agents  α-Lecithin  β-Lecithin wherein RC(O)- represents the residue of stearic, palmitic, or oleic acid
Hydrogenated Lecithin 92128-87-5 [308068-11-3]	Hydrogenated Lecithin is the end-product of the controlled hydrogenation of Lecithin. **Functions:** Dispersing Agents - Nonsurfactant; Skin-Conditioning Agents - Miscellaneous; Surfactants - Emulsifying Agents
Lysolecithin (Hydrolyzed Lecithin) 9008-30-4 [85711-58-6]	Lysolecithin is the product obtained from acid, enzyme or other method of hydrolysis of lecithin. **Functions:** Surfactants - Emulsifying Agents
Hydrogenated Lysolecithin	Hydrogenated Lysolecithin is the product obtained by the controlled hydrogenation of Lysolecithin. **Functions:** Surfactants - Emulsifying Agents
Phospholipids 123465-35-0	Phospholipids are complex lipids in which one of the primary hydroxyl groups of glycerin is esterified with phosphoric acid which carries an additional ester grouping. The two remaining hydroxyl groups are esterified with long chain, saturated or unsaturated fatty acids. **Functions:** Skin-Conditioning Agents - Miscellaneous  wherein RC(O)- represents the residue of a naturally occurring fatty acid and R' is "an additional ester grouping."
Hydrolyzed Phospholipids	Hydrolyzed Phospholipids is the hydrolysate of Phospholipids derived by acid, enzyme or other method of hydrolysis. **Functions:** Skin-Conditioning Agents - Miscellaneous
Phosphatidic Acid [308069-40-1]	Phosphatidic Acid is the phospholipid in which one of the primary hydroxyl groups of glycerin is esterified with phosphoric acid; and the two remaining hydroxyl groups are esterified with long chain, saturated or unsaturated fatty acids. **Functions:** Skin-Conditioning Agents - Emollient; Surfactants - Emulsifying Agents 
Lysophosphatidic Acid	Lysophosphatidic Acid is the organic compound that conforms to the formula below **Functions:** Hair Conditioning Agents; Humectants; Skin Protectants; Skin-Conditioning Agents – Miscellaneous  where RCO- represents a long chain saturated or unsaturated fatty acid.

Ingredient & CAS No.	Definitions, Structures, and Functions
Phosphatidylglycerol 92347-24-5	Phosphatidylglycerol is the phospholipid that conforms to the following formula. **Functions:** Emulsion Stabilizers; Skin Protectants; Skin-Conditioning Agents - Miscellaneous; Surfactants - Emulsifying Agents  wherein RC(O)- represents the residue of a naturally occurring fatty acid.
Lysophosphatidylglycerol	Lysophosphatidylglycerol is the hydrolysate of phosphatidylglycerol obtained by the reaction of phospholipase A2. **Functions:** Skin-Conditioning Agents - Humectant; Surfactants - Emulsifying Agents
Phosphatidylserine [1446756-47-3]	Phosphatidylserine is the phospholipid that conforms to the following formula. **Functions:** Emulsion Stabilizers; Hair Conditioning Agents; Skin Protectants; Skin-Conditioning Agents - Miscellaneous  wherein RC(O)- represents the residue of a naturally occurring fatty acid.
Ammonium Phosphatidyl Rapeseedate 100085-59-4	Ammonium Phosphatidyl Rapeseedate is the product formed by the reaction of ammonium phosphatide and hydrogenated rapeseed oil. **Functions:** Emulsion Stabilizers; Skin-Conditioning Agents - Emollient; Surfactants - Emulsifying Agents  wherein RC(O)- represents the residue of a naturally occurring fatty acid common to hydrogenated rapeseed oil.
Phosphatidylcholine [97281-48-6] [97281-45-3] [92129-12-9]	Phosphatidylcholine is a purified grade of Lecithin containing no less than 95% of the phospholipid that conforms to the following formula. **Functions:** Skin-Conditioning Agents - Miscellaneous; Surfactants - Emulsifying Agents  wherein RC(O)- represents the residue of a naturally occurring fatty acid.
Hydrogenated Phosphatidylcholine 97281-48-6	Hydrogenated Phosphatidylcholine is the end-product of the controlled hydrogenation of Phosphatidylcholine. **Functions:** Skin-Conditioning Agents - Miscellaneous; Surfactants - Emulsifying Agents
Hydrogenated Lysophosphatidylcholine [1332834-64-6]	Hydrogenated Lysophosphatidylcholine is the end-product of the controlled hydrogenation of lysophosphatidylcholine. **Functions:** Emulsion Stabilizers; Skin-Conditioning Agents - Miscellaneous; Surfactants - Emulsifying Agents
Lysophosphatidylethanolamine [19805-23-3]	Lysophosphatidylethanolamine is the hydrolysate of phosphatidylethanolamine obtained by acid, enzyme or other method of hydrolysis. **Functions:** Humectants; Skin Bleaching Agents; Skin Protectants; Skin-Conditioning Agents - Miscellaneous

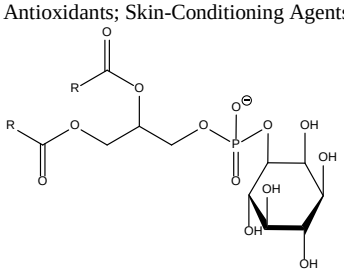
Ingredient & CAS No.	Definitions, Structures, and Functions
Phosphatidylinositol	Phosphatidylinositol is the phospholipid that conforms to the following formula **Functions:** Antioxidants; Skin-Conditioning Agents - Miscellaneous; Surfactants - Emulsifying Agents  wherein RC(O)- represents naturally occurring fatty acids.

Table 2. Specifications for Lecithin and Related Ingredients

Chemical	Organoleptic Characteristics	Physico-chemical Characteristics	Microbiological Characteristics
Lecithin (Emulmetik™ 100, defined as Liquid Soybean Lecithin)	Vicscous, brown liquid with characteristic odor	Acid insolubles (60-100%); Hexane Insolubles (≤ 0.1%); Acid Value (0-32% KOH/g); Peroxide Value (0-5 mEq/Kg); Gardner color value (<14, when undiluted); Moisture (0-0.8%); Viscosity at 25°C (0-10 Pa.s)	Total Plate Count (< 1,000/g); Yeasts (<30/g); Molds (<30/g); *S. aureus* (absent); *P. aeruginosa* (absent); *C. albicans* (absent).[7]
Lecithin (Emulmetik™ 300, defined as Soybean Phospholipids Powder)	Yellow-brown powder with characteristic odor	Acetone Insolubles (97-100%); Toluene Insolubles (0-0.1%); Hexane Insolubles (≤ 0.3%); Phosphatidylethanolamine (17-22%); Phosphatidic Acid (2-9%); Phosphatidylinositol (12-18%); Phosphatidylcholine (22-27%); Acid Value (0-35 KOH/g); Peroxide Value (0-5 mEq/Kg); Moisture (0-1.5%); pH (6-7 at 1%)	Total Plate Count (<500/g); Molds and Yeasts (<100/g); Coliforms (absent); *Salmomellae* (absent).[8]
Hydrogenated Lecithin (Emulmetik™ 320, defined as Hydrogenated Deoiled Soybean Lecithin)	Beige-gray powder with characteristic odor	Phosphatidylcholine (18-26%); Phosphatidylethanolamine (15-22%); Phosphatidylinositol (10-16%); Phosphorus (2.9-3.1%);Residual Protein (undetectable, based on toluene insolubles value); Iodine Value (0-12, using WIJS method); moisture (0-1.5%); pH (6-7.5 at 1%)	Total Plate Count (<1,000/g); Molds and Yeasts (<100/g); *Enterobacteriaceae* (absent); *Salmonellae* (absent).[9]
Lecithin (Emulmetik™ 900, defined as Purified Soybean Phospholipids)	Brown wax with characteristic odor	Toluene Insolubles (< 0.3%); Phosphatidylcholine (45-100%); Phosphatidylethanolamine (10-100%); Phosphatidic Acid (0-3%); Phosphatidylinositol (0-3%); Peroxide Value (0.5 mEq/Kg); Iodine Color Value (0-45 at 10% in toluene); Moisture (0-1%)	Total Plate Count (<1,000/g); Molds and Yeasts (<100/g); *Enterobacteriaceae* (absent); *Salmonellae* (absent).[10]
Phosphatidylcholine (Emulmitek™ 930, defined as Purified Soybean Phosphatidylcholine)	Light yellow flakes with characteristic odor	Toluene Insolubles (< 0.3%); Phosphatidylcholine (92-100%); Lyso-phosphatidylcholine (0-3%); Phosphorus (3.6-3.9%); Peroxide Value (0-5 mEq/Kg); Iodine Value (>95 mg/g); Moisture (0-0.8%)	Total Plate Count (<1,000/g); Molds and Yeasts (<100/g); *Enterobacteriaceae* (absent); *Salmonellae* (absent).[11]
Hydrogenated Lecithin (Emulmitek™ 950, defined as Purified Hydrogenated Soybean Phosphatidylcholine)	White powder with characteristic odor	Phosphatidylcholine (94-100%); Lyso-phosphatidylcholine (0-1%); Phosphorus (3.7-4%); Protein (undetectable, using Bradford method); Peroxide Value (0-5 mEq/Kg); Iodine Value (0-3 mg/g); Moisture (0-0.5%)	Total Plate Count (<1,000/g); Molds (<50/g); Yeasts (<50/g); *Enterobacteriaceae* (absent); *Salmonellae* (absent).[12]
Lysolecithin (Emulmitek™ 120, defined as Hydrolyzed Soybean Lecithin)	Viscous brown liquid with characteristic odor	Acetone Insolubles (56-100%); Acid Value (0-40 mg KOH/g); Peroxide Value (0-5 mEq/Kg); Moisture (0-1%); Viscosity at 25°C (0-10 Pa.s); Iodine Color Value (0-65 at 10% in toluene)	Total Plate Count (<1,000/g); Molds and Yeasts (<60/g); *Enterobacteriaceae* (absent); *Salmonellae* (absent).[13]

Table 2. Specifications for Lecithin and Related Ingredients

Chemical	Organoleptic Characteristics	Physico-chemical Characteristics	Microbiological Characteristics
Lecithin (Emulmitek™ 970, defined as Egg Lecithin Powder)	Yellow-brown paste with characteristic odor	Phosphatidylcholine (59-100%); Phosphatidylethanolamine (6-100%); Moisture (0-2.5%); Acid Value (0-25 mg KOH/g); Iodine Value (65-100 mg/g); Peroxide Value (0-5 mEq/Kg); Iodine Color Value (<60 at 10% in toluene); Triglycerides (0-15%); Cholesterol (0-8%)	Total Plate Count (<1,000/g); Molds and Yeasts (<50/g); *Enterobacteriaceae* (absent); *Salmonellae* (absent).[14]
Lecithin (Ovothin™ 120, defined as Egg Oil)	Yellow-brown semisolid with characteristic odor	Phospholipids (>30%); Cholesterol (0-5%); Acid Value (0-25 mg KOH/g); Peroxide Value (0-3 mEq/Kg); Iodine Value (>70 g/100 g); Iodine Color Value (<55 at 10% in toluene); Moisture (0-2%)	Total Plate Count (<500/g); Molds and Yeasts (absent); *S. aureus (absent); Enterobacteriaceae* (absent); *Salmonella* (absent).[15]
Phospholipids (LECI-PS 20 P IP, defined as Lecithin Rich in Phosphatidylserine)	Yellowish powder with characteristic odor	Phosphatidylserine (20-100%); Phosphatidylcholine (10-100%); Phosphatidylethanolamine (0-12%); Phosphatidylinositol (0-13%); Peroxide Value (maximum of 5 mEq/Kg); and moisture (0-2%)	Total Plate Count (< 1,000/g); Molds and Yeasts (<100/g).[16]

Table 3. Current Frequency and Concentration of Use According to Duration and Type of Exposure.[23,24]

	Lecithin		**Hydrogenated Lecithin**		**Lysolecithin**	
	# of Uses	Conc. (%)	# of Uses	Conc. (%)	# of Uses	Conc. (%)
Totals/Conc. Range	1983	0.00000008-50	691	0.000001-5	74	0.0001-0.2
Duration of Use						
Leave-On	843	0.00000008-50	614	0.000001-5	61	0.0001-0.2
Rinse off	318	0.0000008-11.5	77	0.00055-5	13	NR
Diluted for (bath) Use	2	0.35	NR	0.2	NR	NR
Exposure Type						
Eye Area	374	0.0005-2.5	75	0.000005-1.5	1	0.0001
Incidental Ingestion	125	0.01-3.4	53	0.001-0.14	1	NR
Incidental Inhalation- Sprays	NR	0.0000028-50***	345	0.00003-0.8*	51	0.1
Incidental Inhalation- Powders	1	0.0025-1**	344	0.005-0.56**	47	0.00011-0.2**
Dermal Contact	825	0.00000008-50	611	0.000001-5	73	0.0001-0.2
Deodorant (underarm)	NR	0.000075-0.03	NR	NR	NR	NR
Hair - Non-Coloring	265	0.0000028-2	22	0.00003-1.3	NR	NR
Hair-Coloring	27	0.035	NR	NR	NR	NR
Nail	10	0.002-0.5	NR	0.001	NR	NR
Mucous Membrane	150	0.01-3.4	54	0.001-0.95	1	NR
Baby Products	1	0.015-0.055	2	NR	NR	NR
	Phosphatidylcholine		**Phospholipids**			
	# of Uses	Conc. (%)				
Totals/Conc. Range	29	0.000008-0.8	520	0.000013-0.75		
Duration of Use						
Leave-On	28	0.26-0.8	262	0.000013-0.75		
Rinse off	1	0.000008	58	0.0005-0.17		
Diluted for (bath) Use	NR	NR	4	0.09		
Exposure Type						
Eye Area	10	NR	52	0.0012-0.2		
Incidental Ingestion	NR	NR	73	0.6		
Incidental Inhalation- Sprays	13	0.8	78	0.001		
Incidental Inhalation- Powders	13	NR	79	0.0015-0.75**		
Dermal Contact	28	0.000008-0.8	229	0.000013-0.75		
Deodorant (underarm)	NR	NR	NR	NR		
Hair - Non-Coloring	1	NR	21	0.0005-0.01		
Hair-Coloring	NR	NR	1	NR		
Nail	NR	NR	NR	NR		
Mucous Membrane	NR	NR	97	0.015-0.6		
Baby Products	1	NR	NR	NR		

Lecithin is used in perfumes at max. concentrations up to 0.0021%.
Lecithin is used in hairsprays at max. concentrations up to 0.000014% (aerosol) and up to 0.00015% (pump spray).
Lecithin is used in spray deodorants at max. concentrations up to 0.0029% (aerosol) and up to 0.03% (pump spray).
Lecithin is used in face powders at max. concentrations up to 1%.
Hydrogenated lecithin is used in pump hair sprays at max. concentrations up to 0.8%.
Hydrogenated lecithin is used in moisturizing products (sprays) at a max. concentration of 0.65%.
Hydrogenated lecithin is used in face and neck products (sprays) at a max. concentration of 0.5%.
Hydrogenated lecithin is used in body and hand products (sprays) at max. concentrations up to 0.65%.
Hydrogenated lecithin is used in face powders at max. concentrations up to 0.56%.
Lysolecithin is used in body and hand products (sprays) at a max. concentration of 0.1%.
Phosphatidylcholine is used in body and hand products (spray) at a max. concentration of 0.8%.
Phospholipids are used in aerosol hair sprays at max. concentrations up to 0.001%.

NR = Not Reported; Totals = Rinse-off + Leave-on Product Uses.
*It is possible that these products may be sprays, but it is not specified whether the reported uses are sprays.
**It is possible that these products may be powders, but it is not specified whether the reported uses are powders.
***Not specified whether a powder or spray, so this information is captured for both categories of incidental inhalation.
Note: Because each ingredient may be used in cosmetics with multiple exposure types, the sum of all exposure type uses may not equal the sum total uses.

References

1. Andersen, F. A. Final report on the safety assessment of lecithin and hydrogenated lecithin. *International Journal of Toxicology*. 2001;20(1):21-45.

2. Gennaro, A. R. Remington's Pharmaceutical Sciences. 18th *ed*. Easton: Mack Publishing, 1990.

3. Schlossman, M. L. The chemistry and manufacture of cosmetics. 3rd *ed*. Carol Stream: Allured Publishing Corp., 2002.

4. Barel, A. Paye M. and Maibach H. I. Handbook of cosmetic science and technology. 3rd *ed*. Boca Raton: CRC Press, 2009.

5. Damnjanovic, J. Nakano H. and Iwasaki Y. Simple and efficient profiling of phospholipids in phospholipase D-modiofied soy lecithin by HPLC with charged aerosol detection. *Journal of the American Oil Chemists' Society*. 2013;90(7):951-957.

6. Nikitakis, J. and Breslawec H. P. International Cosmetic Ingredient Dictionary and Handbook. 14 *ed*. Washington, DC: Personal Care Products Council, 2014.

7. Lucas Meyer Cosmetics S.A.S. Emulmetik™ 100 (lecithin) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-9-2014. 2013. pp.1-2.

8. Lucas Meyer Cosmetics S.A.S. Emulmetik™ 300 (lecithin) specification criteria. Unpublised data submitted by the Personal Care Products Council on 10-9-2014. 2014. pp.1-2.

9. Lucas Meyer Cosmetics S.A.S. Emulmitek™ 320 (hydrogenated lecithin) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-9-2014. 2012. pp.1

10. Lucas Meyer Cosmetics S.A.S. Emulmitek™ 900 (lecithin) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-8-2014. 2012. pp.1

11. Lucas Meyer Cosmetics S.A.S. Emulmetik™ 930 (phosphatidylcholine) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-9-2014. 2012. pp.1

12. Lucas Meyer Cosmetics S.A.S. Emulmitek™ 950 (hydrogenated lecithin) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-9-2014. 2013. pp.1

13. Lucas Meyer Cosmetics S.A.S. Emulmetik™ 120 (lysolecithin) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-9-2014. 2012. pp.1

14. Lucas Meyer Cosmetics S.A.S. Emulmetik™ 970 (lecithin) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-9-2014. 2014. pp.1

15. Lucas Meyer Cosmetics S.A.S. Ovothin™ 120 (lecithin) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-9-2014. 2013. pp.1-2.

16. Lucas Meyer Cosmetics S.A.S. LECI-PS 20 P IP (phospholipids) specification criteria. Unpublished data submitted by the Personal Care Products Council on 10-9-2014. 2012. pp.1

17. Food and Drug Administration (FDA). Direct food substances affirmed as generally recognized as safe. Lecithin. 21CFR 184.1400.

18. Food and Drug Administration (FDA). Withdrawn: Guidance on the labeling of certain uses of lecithin derivedfrom soy under section 403(w) of the Federal Food, Drug, and cosmetic Act. http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm059065.htm.

19. Awazuhara, H. Kawai B. Baba M. Matsui T. and Komiyama A. Antigenicity of the proteins in soy lecithin and soy oil in soybean allergy. *Clin.Exp.Allergy*. 1998;28(12):1559-1564.

20. Food and Drug Administration (FDA). Substances added directly to human food affirmed as generally recognized as safe. Enzyme-modified lecithin. 21CFR 184.1063. 2013.

21. Lipogen Products (9000) Ltd. Notification of GRAS determination for soy lecithin phosphatidylserine complex. 2005. pp.1-91.

22. Food and Drug Administration (FDA). Database of Select Committee on GRAS substances (SCOGS) reviews. Lecithin. http://www.fda.gov. Date Accessed 8-10-2014.

23. Food and Drug Administration (FDA). Information supplied to FDA by industry as part of the VCRP FDA database. 2014. Washington, D.C.: FDA.

24. Personal Care Products Council. Concentration of use by FDA product category: Lecithin and other phosphoglycerides. Unpublished data submitted by the Personal Care Products Council on 7-30-2014. 2014. pp.1

25. Rothe H, Fautz R, Gerber E, Neumann L, Rettinger K, Schuh W, and Gronewold C. Special aspects of cosmetic spray safety evaluations: Principles on inhalation risk assessment. *Toxicol Lett*. 2011;205(2):97-104.

26. Bremmer HJ, Prud'homme de Lodder LCH, and van Engelen JGM. Cosmetics Fact Sheet: To assess the risks for the consumer; Updated version for ConsExpo 4. 20200. http://www.rivm.nl/bibliotheek/rapporten/320104001.pdf. Date Accessed 8-24-2011. Report No. RIVM 320104001/2006. pp. 1-77.

27. Rothe H. Special aspects of cosmetic spray evaluation. Unpublished information presented to the 26 September CIR Expert Panel. Washington D.C. 2011.

28. Johnsen MA. The Influence of Particle Size. *Spray Technology and Marketing*. 2004;14(11):24-27.

29. The United States Pharmacopeial Convention. Food Chemicals Codex. 8th *ed*. Rockville: The United States Pharmacopeial Convention, 2012.

30. Food and Drug Administration (FDA). Inactive Ingredients Database. Inactive ingredient search for approved drug products. http://www.accessdata.fda.gov/scripts/cder/iig/getiigWEB.cfm.

31. da Silva, R. P. Kelly K. B. Al Rajabi A. and Jacobs R. L. Novel insights on interactions between folate and lipid metabolism. *Biofactors*. 2014;40(3):277-283.

32. Won, T. J. Nam Y. Lee H. S. Chumng S. Lee J. H. Chung Y. H. Park E. S. Hwang K. W. and Jeong J. H. Injection of phosphatidylcholine and deoxycholic acid regulates gene expression of lipolysis-related factors, pro-inflammatory cytokines, and hormones on mouse fat tissue. *Food and Chemical Toxicology*. 2013;60:263-268.

33. Stein, O. and Stein Y. The fate of intravenously injected 1-C^{14} palmitoyl P^{32}-lysolecithin in the rat. *Life Sciences*. 1965;4:203-208.

34. Pieringer, R. A. and Hokin L. E. Biosynthesis of phosphatidic acid from lysophosphatidic acid and palmitoyl coenzyme A. *Th Journal of Biological Chemistry*. 1962;237(3):659-663.

35. Orlando, P. Cerrito F. and Zirilli P. The fate of double-labelled brain phospholipids administered to mice. *Farmaco*. 1975;30(9):451-458.

36. Mazzari, S. Zanotti A. Orlando P. Raciti R. and Toffano G. Pharmacokinetics and pharmacodynamics of phosphatidylserine liposomes in mice. Antolini, R. Gliozzi A. and Gorio A. In: *Transport in Biomembranes: Model Systems and Reconstitution*. New York: Raven Press; 1982:257-263.

37. Toffano, G. Battistella A. Mazzari S. Orlando P. Massari P. and Giordano C. Fate of phosphatidyl-L-(U-14C) serine in mice. Horrocks, L. A. Ansell G. B. and Porcellati G. In: *Phospholipids in the Nervous System. Volume 1*. New York: Raven Press; 1982:173-180.

38. Toffano, G. Battistella A. and Orlando P. Pharmacokinetics of radiolabelled brain phosphatidylserine. *Clin.Trials J.* 1987;24(1):18-24.

39. Palatini, P. Viola G. Bigon E. Menegus A. M. and Bruni A. Pharmacokinetic characterization of phosphatidylserine liposomes in the rat. *Br.J.Pharmacol.* 1991;102:345-350.

40. Bruni, A. Bellinin F. Mietto L. Boarato E. and Viola G. Phospholipid absorption and diffusion through membranes. Hanin, I. and Pepeu G. In: *Phospholipids. Biochemical, Pharmaceutical, and Analytical Considerations.* New York: Plenum Press; 1990:59-68.

41. Bruni, A. Orlando P. Mietto L. and Viola G. Phospholipid metabolism in rat intestinal mucosa after oral administration of lysophospholipids. Bazan, N. G. In: *Neurobiology of Essential Fatty Acids*. New York: Plenum Press; 1992:

42. Kuge, O. and Nishijima M. Biosynthetic regulation and intracellular transport of phosphatidylserine in mammalian cells. *J.Biochem.* 2003;133(4):397-403.

43. Linder, M. C. Nutrition and metabolism of fats. Linder, M. C. In: *Nutritional Biochemistry and Metabolism: With Clinical Applications*. 2nd ed. New York: Elsevier Science Publishing company, Inc.; 2014:51-84.

44. Krummel, D. Lipids [and Polyunsaturated fatty acids]. Philadelphia/Toronto: W.B. Saunders Company; 1996:49-62.

45. Thorne Research, Inc. Phosphatidylserine. *Alternative Medicine Review*. 2008;13(3):245-247.

46. Fujii, M. Shiozawa K. Watanabe Y. and Matsumoto M. Effect of phosphatidylcholine on skin permeation of indomethacin from gel prepared with liquid paraffin and hydrogenated phospholipid. *International Journal of Pharmaceutics*. 2001;222:57-64.

47. Yokomizo, Y. and Sagitani H. Effects of phospholipids on the perctaneous penetration of indomethacin through the dorsal skin of guinea pigs in vitro. *Journal of Controlled Release*. 1996;38:267-274.

48. Heywood, R. Cozens D. D. and Richold M. Toxicology of a phosphatidylserine preparation from bovine brain (BC-PS). *Clin.Trials J.* 2014;24(1):25-32.

49. Myers, M. A. Thomas D. A. Straub L. Soucy D. W. Niven R. W. Kaltenbach M. Hood C. I. Schreier H. and Gonzalez-Rothi R. J. Pulmonary effects of chronic exposure to liposome aerosols in mice. *Experimental Lung Research*. 1993;19:1-19.

50. Brantom, P. G. Gaunt I. F. Jardy J. Grasso P. and Gangolli S. D. Long-term feeding and reproduction studies on emulsifier YN in rats. *Food Cosmet.Toxico.* 1973;11:755-769.

51. Enzymotec, Ltd. Subchronic toxicity evaluation of phosphatidylserine in elderly rat model. www.enzymotec.com. Date Accessed 7-7-2014.

52. Jorissen, B. L. Brouns F. Van Boxtel M. P. and Riedel W. J. Safety of soy-derived phosphatidylserine in elderly people. *Nutr.Neurosci.* 2002;5(5):337-343.

53. Jeannet, M. and Hassig A. The role of lysophosphatides and fatty acids in hemolysis. *Vox.Sang.* 1964;9:113-127.

54. Robinson, N. Review article. Lysolecithin. *J.Pharm.Pharmacol.* 1961;13(1):321-354.

55. Caccin, P. Rigoni M. Bisceglie A. Rossetto O. and Montecucco C. Reversible skeletal neuromuscular paralysis induced by different lysophospholipids. *FEBS Letters*. 2006;580(27):6317-6321.

56. Kato, S. Aoshima H. Saitoh Y. and Miwa N. Biological safety of liposome-fullerene consisting of hydrogenated lecithin, glycine soja sterols, and fullerene-C60 upon photocytotoxicity and bacterial reverse mutagenicity. *Toxicology and Industrial Health*. 2009;25:197-203.

57. Beliveau, S. Gaudreault P. Goulet L. Primeau M. N. and Marcoux D. Type I hypersensitivity in an asthmatic child allergic to peanuts: was soy lecithin to blame? *J.Cutan.Med.Surg.* 2008;12(1):27-30.

58. Middleton, E. Jr. and Phillips G. B. Release of histamine activity in human skin by lysolecithin. *Laboratory and Clinical Medicine*. 1964;64(6):889-894.

59. Nagamatsu, T. Iwasawa-Kawai Y. Ichikawa M. Kawana K. Yamashita T. Osuga Y. Fujii T. and Schust D. J. Emerging roles for lysophospholipid mediators in pregnancy. *American Journal of Reproductive Immunology*. 2014;72:182-191.

60. Jo, J. W. Jee B. C. Suh C. S. and Kim S. H. Addition of lysophosphatidic acid to mouse oocyte maturation media can enhance fertilization and developmental competence. *Human Reproduction*. 2014;29(2):234-241.

61. Bojanowski, K. Hypodermal delivery of cosmetic actives for improved facial skin morphology and functionality. *International Journal of Cosmetic Science*. 2013;35:562-567.

62. Szepsenwol, J. Brain nerve cell tumors in mice on diets supplemented with various lipids. *Pathol.Miocrobiol.* 1969;34:1-9.

63. Mori, K. Kondo M. and Suzuki S. Induction of lung cancer in mice and rats by injections of 4-nitroquinoline 1-oxide in lecithin. *Gann*. 1966;57:559-561.

64. Bassett, J. K. Severi G. Hodge A. M. MacInnis R. J. Gibson R. A. Hopper J. L. English D. R. and Giles G. G. Plasma phospholipid fatty acids, dietary fatty acids and prostate cancer risk. *International Journal of Cancer*. 2013;133:1882-1891.

65. Dueck, D. Chan M. Tran K. Wong J. T. Jay F. T. Littman C. K. Stimpson R. and Choy P. C. The modulation of choline phospholglyceride metabolism in human colon cancer. *Molecular and Cellular Biochemistry*. 1996;162:97-103.

66. Tania, M. Khan M. A. and Song Y. Association of lipid metabolism with ovarian cancer. *Current Oncology*. 2010;17(5):6-11.

67. Ricci, A. and Podo E. I. F. Alterations of choline phospholipid metabolism in ovarian tumor progression: a nmr study. *Biophy.Bioeng.Lett.* 2008;1:1-8.

68. Spiegel, S. Lysophosphatidic acid rwegulation and roles in human prostate cancer. Annual report. Funding Number: DAMD17-02-1-0060. 2005. pp.1-68. Fort Detrick: U.S. Army Medical Research and Material Command.

69. Xu, Y. Shen Z. Wiper D. W. Wu M. Morton R. E. Elson P. Kennedy A. W. Belinson J. Markman M. and Casey G. Lysophosphatidic acid as a potential biomarker for ovarian and other gynecologic cancers. *JAMA.* 1998;280(8):719-723.

70. Tsujiuchi, T. Hirane M. Dong Y. and Fukushima N. Diverse effects of LPA receptors on cell motile activities of cancer cells. *Journal of Receptors and Signal Transduction.* 2014;34(3):149-153.

71. Xu, Y. Gaudette D. C. Boynton J. D. Frankel A. Fang X. J. Sharma A. Hurteau J. Casey G. Goodbody A. and Mellors A. Characterization of an ovarian cancer activating factor in ascites from ovarian cancer patients. *Clin.Cancer.Res.* 1995;1:1223-1232.

72. Westermann, A. M. Havik E. Postma F. R. Beijnen J. H. Dalesio O. Moolenaar W. H. and Rodenhuls S. Malignant effusions contain lysophosphatidic acid (LPA)-like activity. *Annals of Oncology.* 1998;9(4):437-442.

73. Yung, Y. C. Srtoddard N. C. and Chun J. LPA receptor signaling: pharmacology, physiology, and pathophysiology. *J.Lipid Res.* 2014;55:1192-1214.

74. Schwartz, H. P. Dreisbach L. Stambaugh R. Kleschick A. and Barrionievo M. Chromatography of the phospholipids of rabbit skin. *Archives of Biochemistry and Biophysics.* 1960;87:171-178.

75. Lampe, M. A. Burlingame A. L. Whitney J. Williams M. L. Brown B. E. Roitman E. and Elias P. M. Human stratum corneum lipids: characterization and regional variations. *Journal of Lipid Research.* 1983;24:120-130.

76. Kiyasu, J. Y. Pieringer R. A. Paulus H. and Kennedy E. P. The biosynthesis of phosphatidylglycerol. *J.Biol.Chem.* 1963;238:2293-2298.

77. Hoffmann, P. R. Kench J. A. Vondracek A. Kruk E. Daleke D. L. Jordan M. Marrack P. Henson P. M. and Fadok V. A. Interaction between phosphatidylserine and the phosphatidylserine receptor inhibits immune responses *in vivo*. *J.Immunol.* 2005;174(3):1393-1404.

2014 FDA VCRP Data

Lecithin

01B - Baby Lotions, Oils, Powders, and Creams	1
02A - Bath Oils, Tablets, and Salts	2
03A - Eyebrow Pencil	11
03B - Eyeliner	76
03C - Eye Shadow	84
03D - Eye Lotion	46
03F - Mascara	86
03G - Other Eye Makeup Preparations	70
04C - Powders (dusting and talcum, excluding aftershave talc)	2
04E - Other Fragrance Preparation	5
05A - Hair Conditioner	110
05B - Hair Spray (aerosol fixatives)	5
05D - Permanent Waves	1
05E - Rinses (non-coloring)	2
05F - Shampoos (non-coloring)	91
05G - Tonics, Dressings, and Other Hair Grooming Aids	53
05H - Wave Sets	1
05I - Other Hair Preparations	60
06A - Hair Dyes and Colors (all types requiring caution statements and patch tests)	2
06B - Hair Tints	22
06H - Other Hair Coloring Preparation	3
07A - Blushers (all types)	25
07B - Face Powders	55
07C - Foundations	79
07E - Lipstick	124
07F - Makeup Bases	11
07G - Rouges	6
07H - Makeup Fixatives	1
07I - Other Makeup Preparations	50
08B - Cuticle Softeners	2
08C - Nail Creams and Lotions	2
08E - Nail Polish and Enamel	2
08F - Nail Polish and Enamel Removers	1
08G - Other Manicuring Preparations	3
10A - Bath Soaps and Detergents	11
10E - Other Personal Cleanliness Products	8
11A - Aftershave Lotion	15
11E - Shaving Cream	2
11F - Shaving Soap	4
11G - Other Shaving Preparation Products	3
12A - Cleansing	27
12C - Face and Neck (exc shave)	175
12D - Body and Hand (exc shave)	150

12F - Moisturizing	272
12G - Night	80
12H - Paste Masks (mud packs)	24
12I - Skin Fresheners	4
12J - Other Skin Care Preps	87
13A - Suntan Gels, Creams, and Liquids	5
13B - Indoor Tanning Preparations	8
13C - Other Suntan Preparations	8
03D - Eye Lotion	1
07E - Lipstick	1
10A - Bath Soaps and Detergents	1
10E - Other Personal Cleanliness Products	3
12A - Cleansing	1
12D - Body and Hand (exc shave)	6
12H - Paste Masks (mud packs)	1
Total	**1991**

Hydrogenated Lecithin

01B - Baby Lotions, Oils, Powders, and Creams	1
01C - Other Baby Products	1
03B - Eyeliner	3
03C - Eye Shadow	13
03D - Eye Lotion	28
03F - Mascara	5
03G - Other Eye Makeup Preparations	26
05A - Hair Conditioner	9
05E - Rinses (non-coloring)	1
05F - Shampoos (non-coloring)	4
05G - Tonics, Dressings, and Other Hair Grooming Aids	6
05I - Other Hair Preparations	2
07A - Blushers (all types)	10
07B - Face Powders	15
07C - Foundations	26
07E - Lipstick	53
07F - Makeup Bases	12
07I - Other Makeup Preparations	27
10A - Bath Soaps and Detergents	1
11A - Aftershave Lotion	11
11E - Shaving Cream	2
11G - Other Shaving Preparation Products	1
12A - Cleansing	36
12C - Face and Neck (exc shave)	141
12D - Body and Hand (exc shave)	27
12F - Moisturizing	123
12G - Night	33
12H - Paste Masks (mud packs)	23
12I - Skin Fresheners	4

12J - Other Skin Care Preps	36
13A - Suntan Gels, Creams, and Liquids	8
13B - Indoor Tanning Preparations	3
Total	**691**

Lysolecithin

03D - Eye Lotion	1
04E - Other Fragrance Preparation	1
07C - Foundations	2
07E - Lipstick	1
07F - Makeup Bases	3
07I - Other Makeup Preparations	1
12A - Cleansing	7
12C - Face and Neck (exc shave)	30
12D - Body and Hand (exc shave)	6
12F - Moisturizing	10
12H - Paste Masks (mud packs)	6
12I - Skin Fresheners	1
12J - Other Skin Care Preps	2
13A - Suntan Gels, Creams, and Liquids	3
Total	**74**

Phospholipids

02A - Bath Oils, Tablets, and Salts	1
02B - Bubble Baths	2
02D - Other Bath Preparations	1
03C - Eye Shadow	4
03D - Eye Lotion	27
03G - Other Eye Makeup Preparations	21
04E - Other Fragrance Preparation	1
05A - Hair Conditioner	11
05B - Hair Spray (aerosol fixatives)	2
05F - Shampoos (non-coloring)	5
05G - Tonics, Dressings, and Other Hair Grooming Aids	22
05I - Other Hair Preparations	5
06G - Hair Bleaches	1
07A - Blushers (all types)	1
07B - Face Powders	3
07C - Foundations	13
07E - Lipstick	73
07F - Makeup Bases	1
07I - Other Makeup Preparations	2
10A - Bath Soaps and Detergents	15
10E - Other Personal Cleanliness Products	5
11A - Aftershave Lotion	1
12A - Cleansing	14
12C - Face and Neck (exc shave)	73

12D - Body and Hand (exc shave)	44
12E - Foot Powders and Sprays	1
12F - Moisturizing	97
12G - Night	28
12H - Paste Masks (mud packs)	7
12I - Skin Fresheners	2
12J - Other Skin Care Preps	33
13A - Suntan Gels, Creams, and Liquids	3
13B - Indoor Tanning Preparations	1
Total	**520**

Lysophosphatidic Acid

12C - Face and Neck (exc shave)	2
Total	2

Phosphatidylcholine

01B - Baby Lotions, Oils, Powders, and Creams	1
03D - Eye Lotion	2
03G - Other Eye Makeup Preparations	8
05I - Other Hair Preparations	1
12C - Face and Neck (exc shave)	1
12D - Body and Hand (exc shave)	7
12F - Moisturizing	2
12G - Night	2
12H - Paste Masks (mud packs)	1
12J - Other Skin Care Preps	3
13B - Indoor Tanning Preparations	1
Total	**29**

Personal Care Products Council
Committed to Safety, Quality & Innovation

Memorandum

TO: Lillian Gill, D.P.A.
Director - COSMETIC INGREDIENT REVIEW (CIR)

FROM: Beth A. Lange, Ph.D.
Industry Liaison to the CIR Expert Panel

DATE: October 27, 2014

SUBJECT: Updated Concentration of Use by FDA Product Category: Lecithin and Other Phospholipids

Concentration of Use by FDA Product Category*

Lecithin
Hydrogenated Lecithin
Lysolecithin (Hydrolyzed Lecithin)
Hydrogenated Lysolecithin
Phospholipids
Hydrolyzed Phospholipids
Phosphatidic Acid
Lysophosphatidic Acid
Phosphatidylglycerol
Lysophosphatidylglycerol
Phosphatidylserine
Ammonium Phosphatidyl Rapeseedate
Phosphatidylcholine
Hydrogenated Phosphatidylcholine
Hydrogenated Lysophosphatidylcholine
Lysophosphatidylethanolamine
Phosphatidylinositol

Ingredient	Product Category	Maximum Concentration of Use
Lecithin	Baby shampoo	0.055%
Lecithin	Baby lotion, oils and creams not powder	 0.015%
Lecithin	Bath oils, tablets and salts	0.35%
Lecithin	Eyebrow pencil	0.0005-0.5%
Lecithin	Eyeliner	0.011-1.4%
Lecithin	Eye shadow	0.01-2.5%
Lecithin	Eye lotion	0.0014-0.75%
Lecithin	Eye makeup remover	0.46%
Lecithin	Mascara	0.004-1.3%
Lecithin	Other eye makeup preparations	0.5%
Lecithin	Colognes and toilet waters	0.0014-0.01%
Lecithin	Perfumes	0.0013-0.0021%
Lecithin	Other fragrance preparations	0.028-0.37%
Lecithin	Hair conditioners	0.0003-2%
Lecithin	Hair sprays aerosol pump spray	 0.0000028-0.000014% 0.000018-0.00015%
Lecithin	Shampoos (noncoloring)	0.00003-0.1%
Lecithin	Tonics, dressings and other hair grooming aids	0.00002-2%
Lecithin	Other hair preparations (noncoloring)	0.018-0.4%
Lecithin	Hair dyes and colors	0.035%
Lecithin	Blushers	0.00005%
Lecithin	Face powders	0.0025-1%
Lecithin	Foundation	0.01-1.1%
Lecithin	Lipstick	0.01-3.4%
Lecithin	Makeup bases	0.76%
Lecithin	Rouge	0.00015%
Lecithin	Makeup fixatives	0.01%
Lecithin	Other makeup preparations	0.05-0.4%
Lecithin	Other manicuring preparations	0.002-0.5%

Lecithin	Other oral hygiene products	0.01%
Lecithin	Bath soaps and detergents	0.0003-0.1%
Lecithin	Deodorants not spray aerosol pump spray	 0.000075-0.003% 0.00018-0.0029% 0.0003-0.03%
Lecithin	Aftershave lotions	0.0006-0.2%
Lecithin	Shaving cream	0.00014-0.15%
Lecithin	Shaving soap	0.5%
Lecithin	Skin cleansing (cold creams, cleansing lotions, liquids and pads)	0.0000008-11.5%
Lecithin	Face and neck products not spray	 0.00000008-1.1%
Lecithin	Body and hand products not spray	 0.0003-2%
Lecithin	Foot products	50%
Lecithin	Moisturizing products not spray	 0.0001-0.2%
Lecithin	Night products not spray	 0.0000009-1.3%
Lecithin	Paste masks and mud packs	0.00035-3%
Lecithin	Skin fresheners	0.015%
Lecithin	Other skin care preparations	0.004-0.007%
Lecithin	Suntan products not spray	 0.00003-1%
Lecithin	Indoor tanning preparations	0.015%
Lecithin	Other suntan preparations	0.006%
Hydrogenated Lecithin	Other bath preparations	0.2%
Hydrogenated Lecithin	Eyebrow pencil	0.00005%
Hydrogenated Lecithin	Eyeliner	0.000005%
Hydrogenated Lecithin	Eye shadow	0.1-1.5%
Hydrogenated Lecithin	Eye lotion	0.001-1%
Hydrogenated Lecithin	Mascara	0.1-0.5%
Hydrogenated Lecithin	Other eye makeup preparations	0.009%
Hydrogenated Lecithin	Hair conditioners	0.00055%
Hydrogenated Lecithin	Hair sprays pump spray	 0.00003-0.8%
Hydrogenated Lecithin	Shampoos (noncoloring)	1.3%
Hydrogenated Lecithin	Tonics, dressings and other hair grooming aids	0.00005-0.9%
Hydrogenated Lecithin	Other hair preparations (noncoloring)	1.2%
Hydrogenated Lecithin	Blushers	0.1-0.64%
Hydrogenated Lecithin	Face powder	0.005-0.56%
Hydrogenated Lecithin	Foundation	0.005-3%
Hydrogenated Lecithin	Lipstick	0.001-0.14%
Hydrogenated Lecithin	Makeup bases	0.00005-2.4%
Hydrogenated Lecithin	Makeup fixatives	0.000001%

Hydrogenated Lecithin	Other makeup preparations	0.005%
Hydrogenated Lecithin	Nail polish and enamel	0.001%
Hydrogenated Lecithin	Bath soaps and detergents	0.95%
Hydrogenated Lecithin	Aftershave lotions	0.00078-1%
Hydrogenated Lecithin	Shaving cream	0.2%
Hydrogenated Lecithin	Skin cleansing (cold creams, cleansing lotions, liquids and pads)	0.001-5%
Hydrogenated Lecithin	Face and neck products not spray spray	 0.006-5% 0.5%
Hydrogenated Lecithin	Body and hand products not spray spray	 0.0004-1.5% 0.0014-0.65%
Hydrogenated Lecithin	Moisturizing products not spray spray	 0.0005-1% 0.65%
Hydrogenated Lecithin	Night products not spray	 0.004-1%
Hydrogenated Lecithin	Pastes masks and mud packs	0.045-1%
Hydrogenated Lecithin	Suntan products not spray	 0.009-1.5%
Hydrogenated Lecithin	Other suntan preparations	0.05%
Lysolecithin	Eye lotion	0.0001%
Lysolecithin	Face and neck products not spray	 0.0029-0.2%
Lysolecithin	Body and hand products not spray spray	 0.00011-0.1% 0.1%
Phosphatidylcholine	Skin cleansing (cold creams, cleansing lotions, liquids and pads)	0.000008%
Phosphatidylcholine	Body and hand products spray	 0.8%
Phosphatidylcholine	Moisturizing products not spray	 0.026%
Phospholipids	Other bath preparations	0.09%
Phospholipids	Eye liner	0.06%
Phospholipids	Eye lotion	0.0012-0.2%
Phospholipids	Hair conditioner	0.0005-0.01%
Phospholipids	Hair sprays aerosol	 0.001%
Phospholipids	Shampoo (noncoloring)	0.001-0.0028%
Phospholipids	Tonics, dressings and other hair grooming aids	0.0005%
Phospholipids	Foundation	0.0001-0.51%
Phospholipids	Lipstick	0.6%
Phospholipids	Bath soaps and detergents	0.015%
Phospholipids	Aftershave lotions	0.005%

Phospholipids	Preshave lotions	0.0005%
Phospholipids	Shaving cream	0.17%
Phospholipids	Skin cleansing (cold creams, cleansing lotions, liquids and pads)	0.013%
Phospholipids	Face and neck products not spray	0.0015-0.75%
Phospholipids	Body and hand products not spray	0.0015-0.025%
Phospholipids	Moisturizing products not spray	0.000013-0.38%
Phospholipids	Night products not spray	0.11%
Phospholipids	Paste masks and mud packs	0.02%
Phospholipids	Suntan products not spray	0.0012-0.6%

*Ingredients included in the title of the table but not found in the table were included in the concentration of use survey, but no uses were reported.

Information collected in 2014

Table prepared July 30, 2014

Updated October 27, 2015: Lecithin: added baby lotion oils and creams; deodorant (not spray) high concentration increased from 0.0003% to 0.003%; night products high concentration increased from 0.025% to 1.3%; added skin fresheners; added indoor tanning preparations; Phosphatidylcholine: added moisturizing products; Phospholipids: suntan products high concentration increased from 0.028% to 0.6%

Personal Care Products Council
Committed to Safety, Quality & Innovation

Memorandum

TO: Lillian Gill, D.P.A.
Director - COSMETIC INGREDIENT REVIEW (CIR)

FROM: Beth A. Lange, Ph.D.
Industry Liaison to the CIR Expert Panel

DATE: October 9, 2014

SUBJECT: Specifications for Lecithin and Related Ingredients

Toluene or Hexane Insoluble Matter is a measure of the total impurity content (including protein) of Lecithin and related ingredients. Lecithin used in food must have a Hexane Insoluble value of not more than 0.3% (see Food Chemical Codex, eighth edition, 2012).

Lucas Meyer Cosmetics S.A.S. 2013. Emulmetik™ 100 (Lecithin) specification criteria.

The Hexane Insolubles value for Emulmetik™ 100 is not more than 0.1%.

Lucas Meyer Cosmetics S.A.S. 2014. Emulmetik™ 300 (Lecithin) specification criteria.

The Hexane Insolubles value for Emulmetik™ 300 is not more than 0.3%.

Lucas Meyer Cosmetics S.A.S. 2012. Emulmetik™ 320 (Hydrogenated Lecithin) specification criteria.

Content of residual protein in Emulmetik™ 320 is not detectable based on toluene insolubles value.

Lucas Meyer Cosmetics S.A.S. 2012. Emulmetik™ 900 (Lecithin) specification criteria.

Toluene insolubles value for Emulmetik™ 900 is less than 0.3%.

Lucas Meyer Cosmetics S.A.S. 2012. Emulmetik™ 930 (Phosphatidylcholine) specification criteria.

Toluene insolubles value for . Emulmetik™ 930 is less than 0.3%.

Lucas Meyer Cosmetics S.A.S. 2013. Emulmetik™ 950 (Hydrogenated Lecithin) specification criteria.

Protein not detected in . Emulmetik™ 950 using the Bradford method (a standard analytical method for measuring protein content).

Lucas Meyer Cosmetics S.A.S. 2012. Emulmetik™ 120 (Lysolecithin) specification criteria.

Lucas Meyer Cosmetics S.A.S. 2014. Emulmetik™ 970 (Lecithin) specification criteria.

Lucas Meyer Cosmetics S.A.S. 2013. Ovothin™ 120 (Lecithin) specification criteria.

Lucas Meyer Cosmetics S.A.S. 2012. LECI-PS 20 P IP (Phospholipids) specification criteria.

LUCASMEYER COSMETICS

EMULMETIK™ 100 - SPECIFICATION CRITERIA
SP-EMUL00010-3

DEFINITION	Liquid soybean lecithin
INCI NAME (US)	Lecithin
INCI NAME (EU)	Lecithin
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	USA

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	*LMC-75*	*Viscous liquid*
Colour	*LMC-75*	*Brown*
Odour	*LMC-75*	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Acetone insolubles (%)	*LE-SOP-001*	*60.0 - 100.0*
Acid value (mg KOH/g)	*LE-SOP-002*	*0 - 32.0*
Peroxide value (meq/Kg)	*LE-SOP-003*	*0 - 5.0*
Gardner colour value (undiluted)	*LE-SOP-005*	*< 14*
Moisture (%)	*LE-SOP-007*	*0 - 0.8*
Viscosity at 25°C (Pa.s)	*AM-26*	*0 - 10.0*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*ISO 21149*	*< 1000*
Yeasts (/g)	*ISO 16212*	*<30*
Moulds (/g)	*ISO 16212*	*<30*
S. aureus (/g)	*ISO 22718*	*Absence*
P. aeruginosa (/g)	*ISO 22717*	*Absence*
C. albicans (/g)	*ISO 18416*	*Absence*

STORAGE / PACKAGING :

SHELF LIFE	24 months in its unopened original packaging.
STORAGE TEMPERATURE	< 25°C
STORAGE CONDITIONS	Protect from direct light. Reclose immediately after use.
USE CONDITIONS	Stir well before use. Due to its composition the product may occasionally separate. This does not influence the quality. Stirring at a slightly elevated temperature will rehomogenize the product.
PACKAGING	25 Kg drum.

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 100 - SPECIFICATION CRITERIA
SP-EMUL00010-3

November 26th, 2013

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA. FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 300 - SPECIFICATION CRITERIA
SP-EMUL00050-2

DEFINITION	Soybean phospholipids powder
INCI NAME (US)	Lecithin
INCI NAME (EU)	Lecithin
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Germany

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	-	*Powder*
Colour	-	*Yellow-brown*
Odour	-	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Acetone insolubles (%)	*AM-22*	*97.0 - 100.0*
Toluene insolubles (%)	*AM-36*	*0 - 0.1*
Phosphatidylethanolamine (%)	*AM-53*	*17.0 - 22.0*
Phosphatidic acid (%)	*AM-53*	*2.0 - 9.0*
Phosphatidylinositol (%)	*AM-53*	*12.0 - 18.0*
Phosphatidylcholine (%)	*AM-53*	*20.0 - 27.0*
Acid value (mg KOH/g)	*AM-28*	*0 - 35.0*
Peroxide value (meq/Kg)	*AM-24*	*0 - 5.0*
Moisture (%)	*AM-30*	*0 - 1.5*
pH (1%)	*AM-42 T*	*6.0 - 7.0*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*MB-2.1*	*< 500*
Moulds & Yeasts (/g)	*MB-3.1*	*< 100*
Coliforms (/g)	*MB-4.2.1*	*Absence*
Salmonellae (/25g)	*Oxoid Rapid Test*	*Absence*

STORAGE / PACKAGING :

SHELF LIFE	24 months in its unopened original packaging.
STORAGE TEMPERATURE	< 25°C
STORAGE CONDITIONS	Protect from direct light and air. Reclose immediately after use.
USE CONDITIONS	-
PACKAGING	25 Kg carton with inner polyethylene bag.

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 810 Euros - R.C.S. Nanterre 390 107 332 - N° TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 300 - SPECIFICATION CRITERIA
SP-EMUL00050-2

January 31st, 2014

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 320 - SPECIFICATION CRITERIA
SP-EMUL00070-1

DEFINITION	Hydrogenated deoiled soybean lecithin
INCI NAME (US)	Hydrogenated Lecithin
INCI NAME (EU)	Hydrogenated Lecithin
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Germany

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	-	*Powder*
Colour	-	*Beige - Grey*
Odour	-	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Phosphatidylcholine (%)	*NMR*	*18.0 - 26.0*
Phosphatidylethanolamine (%)	*NMR*	*15.0 - 22.0*
Phosphatidylinositol (%)	*NMR*	*10.0 - 16.0*
Phosphorus (%)	*NMR*	*2.9 - 3.1*
Iodine value (Wijs)	*AM-37*	*0 - 12.0*
Moisture (%)	*AM-30*	*0 - 1.5*
pH (1%)	*AM-42T*	*6.0 - 7.5*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*MB-2.1*	*< 1000*
Moulds & Yeasts (/g)	*MB-3.1*	*< 100*
Enterobacteriaceae (/g)	*MB-4.2.1*	*Absence*
Salmonellae (/25g)	*Oxoid Rapid Test*	*Absence*

STORAGE / PACKAGING :

SHELF LIFE	36 months in its unopened original packaging.
STORAGE TEMPERATURE	< 25°C
STORAGE CONDITIONS	Protect from direct light and air. Reclose immediately after use.
USE CONDITIONS	-
PACKAGING	5 Kg tinplate bucket and 25 Kg metallic drum.

August 22nd, 2012

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N°TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F. +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 900 - SPECIFICATION CRITERIA
SP-EMUL00090-1

DEFINITION	Purified soybean phospholipids
INCI NAME (US)	Lecithin
INCI NAME (EU)	Lecithin
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Germany

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	-	*Wax*
Colour	-	*Brown*
Odour	-	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Phosphatidylcholine (%)	*AM-41*	*45.0 - 100.0*
Phosphatidylethanolamine (%)	*AM-53*	*10.0 - 100.0*
Phosphatidic acid (%)	*AM-53*	*0 - 3.0*
Phosphatidylinositol (%)	*AM-53*	*0 - 3.0*
Peroxide value (meq/Kg)	*AM-24*	*0 - 5.0*
Iodine colour value (10% in toluene)	*AM-25*	*0 - 45*
Moisture (%)	*AM-30*	*0 - 1.0*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*MB-2.1*	*< 1000*
Moulds & Yeasts (/g)	*MB-3.1*	*< 100*
Enterobacteriaceae (/g)	*MB-4.2.1*	*Absence*
Salmonellae (/25g)	*Oxoid Rapid Test*	*Absence*

STORAGE / PACKAGING :

SHELF LIFE	18 months between 4-8°C in its unopened o riginal packaging or 24 months below -18°C.
STORAGE TEMPERATURE	4-8°C / -18°C
STORAGE CONDITIONS	Protect from direct light and air. Reclose immediately after use.
USE CONDITIONS	-
PACKAGING	1 Kg and 5 Kg sealed aluminium bags packed under inert gas.

August 22nd, 2012

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N°TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 930 - SPECIFICATION CRITERIA
SP-EMUL00120-1

DEFINITION	Purified soybean phosphatidylcholine
INCI NAME (US)	
INCI NAME (EU)	Phosphatidyl choline
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Germany

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	-	*Flakes*
Colour	-	*Light yellow*
Odour	-	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Phosphatidylcholine (%)	*AM-41*	*92.0 - 100.0*
Lyso-phosphatidylcholine (%)	*AM-41*	*0 - 3.0*
Phosphorus (%)	*AM-40*	*3.6 - 3.9*
Peroxide value (meq/Kg)	*AM-24*	*0 - 5.0*
Iodine value (mg/g)	*AM-37*	*> 95.0*
Moisture (%)	*AM-30*	*0 - 0.8*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*MB-2.1*	*< 1000*
Moulds & Yeasts (/g)	*MB-3.1*	*< 100*
Enterobacteriaceae (/g)	*MB-4.2.1*	*Absence*
Salmonellae (/25g)	*Oxoid Rapid Test*	*Absence*

STORAGE / PACKAGING :

SHELF LIFE	18 months between 4-8°C in its unopened o riginal packaging or 24 months below -18°C.
STORAGE TEMPERATURE	4-8°C / -18°C
STORAGE CONDITIONS	Protect from direct light and air. Reclose immediately after use.
USE CONDITIONS	-
PACKAGING	2.5 Kg sealed aluminium bag packed under inert gas.

August 22nd, 2012

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N°TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 950 - SPECIFICATION CRITERIA
SP-EMUL00140-2

DEFINITION	Purified hydrogenated soybean phosphatidylcholine
INCI NAME (US)	Hydrogenated Lecithin
INCI NAME (EU)	Hydrogenated Lecithin
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Germany

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	-	*Powder*
Colour	-	*White*
Odour	-	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Phosphatidylcholine (%)	*NMR*	*94.0 - 100.0*
Lyso-phosphatidylcholine (%)	*NMR*	*0 - 1.0*
Phosphorus (%)	*NMR*	*3.7 - 4.0*
Iodine value (mg/g)	*AM-37*	*0 - 3.0*
Moisture (%)	*AM-30*	*0 - 0.5*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*MB-2.1*	*< 1000*
Enterobacteriaceae (/g)	*MB-4.2.1*	*Absence*
Salmonellae (/25g)	*Oxoid Rapid Test*	*Absence*
Yeasts (/g)	*MB-3.1*	*< 50*
Moulds (/g)	*MB-3.1*	*< 50*

STORAGE / PACKAGING :

SHELF LIFE	36 months in its unopened original packaging.
STORAGE TEMPERATURE	< 25°C
STORAGE CONDITIONS	Protect from direct light and air. Reclose immediately after use.
USE CONDITIONS	-
PACKAGING	5 Kg tinplate bucket and 25 Kg steel sheet drum.

February 25th, 2013

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 120 - SPECIFICATION CRITERIA
SP-EMUL00030-1

DEFINITION	Hydrolyzed soybean lecithin
INCI NAME (US)	Lysolecithin
INCI NAME (EU)	Lysolecithin
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Netherlands

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	-	*Viscous liquid*
Colour	-	*Brown*
Odour	-	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Acetone insolubles (%)	*AM-22*	*56.0 - 100.0*
Acid value (mg KOH/g)	*AM-28*	*0 - 40.0*
Peroxide value (meq/Kg)	*AM-24*	*0 - 5.0*
Moisture (%)	*AM-30*	*0 - 1.0*
Viscosity at 25°C (Pa.s)	*AM-26*	*0 - 10.0*
Iodine colour value (10% in toluene)	*AM-25*	*0 - 65*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*MB-2.1*	*< 1000*
Moulds & Yeasts (/g)	*MB-3.1*	*< 60*
Enterobacteriaceae (/g)	*MB-4.2.1*	*Absence*
Salmonellae (/50g)	*ISO 6579*	*Absence*

STORAGE / PACKAGING :

SHELF LIFE	12 months in its unopened original packaging.
STORAGE TEMPERATURE	< 25°C
STORAGE CONDITIONS	Protect from direct light and air. Reclose immediately after use.
USE CONDITIONS	-
PACKAGING	60 Kg hobbock and 200 Kg open-lid or bunghole drum.

November 06th, 2012

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

EMULMETIK™ 970 - SPECIFICATION CRITERIA
SP-EMUL00150-1

DEFINITION	Egg lecithin powder
INCI NAME (US)	Lecithin
INCI NAME (EU)	Lecithin
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Germany

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	*LMC-75*	*Paste*
Colour	*LMC-75*	*Yellow-Brown*
Odour	*LMC-75*	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Phosphatidylcholine (%)	*NMR*	*59.0 - 100.0*
Phosphatidylethanolamine (%)	*NMR*	*6.0 - 100.0*
Moisture (%)	*AM-30*	*0 - 2.5*
Acid value (mg KOH/g)	*AM-28*	*0 - 25.0*
Iodine value (mg/g)	*AME 37b*	*65.0 - 100.0*
Peroxide value (meq/Kg)	*AM-24*	*0 - 5.0*
Iodine colour value (10% in toluene)	*AM-25*	*< 60*
Triglycerides (%)	*AM-50A*	*0 - 15.0*
Cholesterol (%)	*enzymatical*	*0 - 8.0*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*MB-2.1*	*< 1000*
Moulds & Yeasts (/g)	*MB-3.1*	*< 50*
Enterobacteriaceae (/g)	*MB-4.2.1*	*Absence*
Salmonellae (/25g)	*Oxoid Rapid Test*	*Absence*

STORAGE / PACKAGING :

SHELF LIFE	24 months in its unopened original packaging.
STORAGE TEMPERATURE	4-8°C
STORAGE CONDITIONS	Protect from direct light and air. Reclose immediately after use.
USE CONDITIONS	Stir well before use.
PACKAGING	1 Kg and 5 Kg sealed aluminium bags packed under inert gas.

Lucas Meyer Cosmetics S.A.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA. FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

2014

LUCASMEYER COSMETICS

OVOTHIN™ 120 - SPECIFICATION CRITERIA
SP-EMUL00210-1

DEFINITION	Egg oil
INCI NAME (US)	Lecithin
INCI NAME (EU)	Lecithin
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	Absence
PRESERVATIVE(S)	Absence
OTHER(S)	Absence
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Germany

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	-	*Semi-solid*
Colour	-	*Yellow-Brown*
Odour	-	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Phospholipids (%)	*AM-40*	*> 30*
Cholesterol (%)	*enzymatical*	*0 - 5.0*
Acid value (mg KOH/g)	*AM-28*	*0 - 25.0*
Peroxide value (meq/Kg)	*AM-24*	*0 - 3.0*
Iodine value (g/100g)	*Hanus*	*> 70.0*
Iodine colour value (10% in toluene)	*AM-25*	*< 55*
Moisture (%)	*AM-30*	*0 - 2.0*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*MB-2.1*	*< 500*
Moulds & Yeasts (/g)	*MB-3.1*	*Absence*
S. aureus (/g)	*MB-6.1*	*Absence*
Enterobacteriaceae (/10g)	*MB-4.2.1*	*Absence*
Salmonella (/750g)	*Oxoid Rapid Test*	*Absence*

STORAGE / PACKAGING :

SHELF LIFE	24 months in its unopened original packaging.
STORAGE TEMPERATURE	< 8°C
STORAGE CONDITIONS	Protect from light and air. Reclose immediately after use. OVOTHIN 120 contains in a natural way and in small quantities particles having a weak melting point which can separate on the product surface.That doesn't affect any product quality: while stirring up at a slightly high temperature, the product becomes again homogeneous.According to food of hens, the egg lipids can present light variations of color.
USE CONDITIONS	-
PACKAGING	5 Kg and 25 Kg plastic can.

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

OVOTHIN™ 120 - SPECIFICATION CRITERIA
SP-EMUL00210-1

September 30th, 2013

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

LUCASMEYER COSMETICS

LECI-PS 20 P IP - SPECIFICATION CRITERIA
SP-EMUL00190-CH2

DEFINITION	Lecithin rich in phosphatidylserine
INCI NAME (US)	Phospholipids
INCI NAME (EU)	Phospholipids
REGULATORY STATUS	No specific regulation
ANTI-OXIDANT(S)	None
PRESERVATIVE(S)	None
OTHER(S)	None
APPLICATIONS	Cosmetic products
COUNTRY OF ORIGIN	Japan

ORGANOLEPTIC CHARACTERISTICS	METHOD	SPECIFICATIONS
Aspect	*LMC-75*	*Powder*
Colour	*LMC-75*	*Yellowish*
Odour	*LMC-75*	*Characteristic*
PHYSICO-CHEMICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Phosphatidylsérine (%)	*NMR*	*20.0 - 100.0*
Phosphatidylcholine (%)	*NMR*	*10.0 - 100.0*
Phosphatidylethanolamine (%)	*NMR*	*0 - 12.0*
Phosphatidylinositol (%)	*NMR*	*0 - 13.0*
Peroxide value (meq/Kg)	*LMC-07*	*Max. 5.0*
Moisture (%)	*ISO 8534*	*0 - 2.0*
MICROBIOLOGICAL CHARACTERISTICS	**METHOD**	**SPECIFICATIONS**
Total plate count (/g)	*ISO 21149*	*< 1000*
Moulds & Yeasts (/g)	*ISO 16212*	*< 100*

STORAGE / PACKAGING :

SHELF LIFE	24 months in a cool and dry place in its unopened original packaging.
STORAGE TEMPERATURE	< 25°C
STORAGE CONDITIONS	Protect from direct light and air. Reclose immediately after use.
USE CONDITIONS	-
PACKAGING	10 Kg carton

January 13th, 2014

Lucas Meyer Cosmetics S.A.S.
Registered Office :
Tour Franklin - 100/101 Terrasse Boieldieu, 92080 Paris La Défense - France
S.A.S. au capital de 689 610 Euros - R.C.S. Nanterre 390 107 332 - N° TVA: FR 33 390 107 332

Business and Mailing Adress :
ZA les Belles Fontaines - 99 route de Versailles
91160 Champlan - France
T: +33 (0)1 69 10 69 69 - F: +33 (0)1 69 10 69 70

www.lucasmeyercosmetics.com

Personal Care Products Council
Committed to Safety, Quality & Innovation

Memorandum

TO: Lillian Gill, D.P.A.
Director - COSMETIC INGREDIENT REVIEW (CIR)

FROM: Beth A. Lange, Ph.D.
Industry Liaison to the CIR Expert Panel

DATE: October 9, 2014

SUBJECT: Comments on the Scientific Literature Review: Safety Assessment of Lecithin and other Phosphoglycerides as Used in Cosmetics

The Council does not have any suppliers listed for Lysophosphatidylethanolamine.

Additional Information

Although the CIR Expert Panel concluded the data were insufficient to assess safety of Lecithin when used in products that may be inhaled, Lecithin is permitted as an inactive ingredient in aerosol drugs (seen attached pages from FDA's inactive ingredients database).

The issue of protein contamination of lecithin should also be mentioned in this report. For example:

Awazuhara H, Kawai H, Baba M, et al. 1998. Antigenicity of proteins in soy lecithin and soy oil in soybean allergy. *Clin Exp Allergy* 28(12): 1559-1564.

The following case report should also be of interest to the CIR Expert Panel.

Béliveau S, Gaudreault P, Goulet L, et al. 2008. Type 1 hypersensitivity in an asthmatic child allergic to peanuts: was soy lecithin to blame? *J Cutan Med Surg* 12(1): 27-30.

The FDA requirements for allergen labeling of Lecithin from soy and eggs in food should be mentioned in this report.

Key Issues

The definitions of these ingredients indicate that there is overlap among them, eg., phospholipids is a general term, while Phosphatidylserine is a specific compound. The Chemistry section and Summary should include a description of how these ingredients are interrelated. The meaning of the prefix "lyso" should be presented in the Chemistry section.

A brief section on the normal role of phospholipids in the body should be added to the report. Perhaps a recent review can be referenced for the details.

Additional Comments

p.2-3 - In the Cosmetic Use section, please compare the use of Lecithin and Hydrogenated Lecithin reported in the original report to the new use information. Somewhere in the report, please state the ingredients with no reported use in other cosmetic products.

p.6 - Please correct "pale color nods"

p.6 - The meaning of 65% stated numerous times in all of the summaries of information from the old report is not clear. In what species was the single-insult patch test completed?

p.11 - The sentences that starts with "All of the animals dosed with 4-nitroquinoline-1-oxide..." needs to be revised because it is suggesting that "all of the animals" had skin neoplasia at the injection site and leukemia, in addition to pulmonary neoplasm. Please correct "obsercved"

p.11 - The subsections on Tumor Composition and Carcinogenicity Mechanisms are not relevant to Carcinogenicity and could be briefly mentioned in a section on the normal role of phospholipids.

p.12 - The subsections on Skin Composition and Biosynthesis should also be in a section on the normal role of phospholipids. If information on the composition of mouse skin is included in the report, information on the composition of human skin should be added to the report. For example:

Lampe MA, Burlingame AL, Whitney J, Williams ML, Brown BE, Roitman E, Elias PE. 1983. Human stratum corneum lipids: characterization and regional variations. *Journal of Lipid Research* 24: 120-130. (the complete article was found on the internet at http://www.jlr.org/content/24/2/120.full.pdf)

p.12-13 - It is not clear why the section on dermal penetration enhancement is in the Other Studies section instead of the Toxicokinetics section.

Table 2 - The Council concentration of use survey has subcategories, not spray, aerosol and pump spray for the deodorant product category. These subcategories should be indicated in the use tables in CIR reports.

The foot note ***Not specified whether a powder or spray, so this information is captured for both categories of incidental inhalation does not make sense for Lysolecithin spray row - the 0.1% product was a spray product - it was specified that it was a spray product. The product containing 0.8% Phosphatidylcholine was also specified as being a spray product, making the *** footnote inappropriate in the spray row.

Search Results for: "lecithin"

INACTIVEINGREDIENT[6]	ROUTE;DOSAGE FORM[7]	CAS NUMBER[8]	UNII[9]	MAXIMUM POTENCY[10]
COCONUT OIL - LECITHIN	ORAL; CAPSULE, SOFT GELATIN		Pending	
HYDROGENATED SOYBEAN LECITHIN	AURICULAR (OTIC); SUSPENSION, LIQUID		H1109Z9J4N	0.15%
HYDROGENATED SOYBEAN LECITHIN	TOPICAL; EMULSION, CREAM		H1109Z9J4N	1.5%
LECITHIN	INHALATION; AEROSOL, METERED	8002435	N/A	0.0002%
LECITHIN	INTRAMUSCULAR; INJECTION	8002435	N/A	2.3%
LECITHIN	INTRAMUSCULAR; POWDER, FOR INJECTION SOLUTION	8002435	N/A	
LECITHIN	ORAL; BAR, CHEWABLE	8002435	N/A	54MG
LECITHIN	ORAL; CAPSULE	8002435	N/A	15MG
LECITHIN	ORAL; CAPSULE, COATED, SOFT GELATIN	8002435	N/A	1MG
LECITHIN	ORAL; CAPSULE, SOFT GELATIN	8002435	N/A	
LECITHIN	ORAL; CAPSULE, SOFT GELATIN LIQUID-FILLED	8002435	N/A	325MG
LECITHIN	ORAL; CAPSULE, SUSTAINED ACTION	8002435	N/A	
LECITHIN	ORAL; POWDER, FOR SUSPENSION	8002435	N/A	3.34%
LECITHIN	ORAL; SUSPENSION	8002435	N/A	11%
LECITHIN	ORAL; TABLET	8002435	N/A	10MG
LECITHIN	RECTAL; SUPPOSITORY	8002435	N/A	6.5MG
LECITHIN	TOPICAL; GEL	8002435	N/A	1%
LECITHIN	TOPICAL; SOLUTION	8002435	N/A	1.4%
LECITHIN	TRANSDERMAL; FILM, CONTROLLED RELEASE	8002435	N/A	9.86MG
LECITHIN	VAGINAL; EMULSION, CREAM	8002435	N/A	1%
LECITHIN UNBLEACHED	TOPICAL; EMULSION, CREAM		N/A	0.81%
LECITHIN, EGG	INTRAVENOUS; EMULSION, INJECTION	93685906	1Z74184RGV	1.2%
LECITHIN, EGG	INTRAVENOUS; INJECTABLE	93685906	1Z74184RGV	1.2%
LECITHIN, EGG	ORAL; TABLET	93685906	1Z74184RGV	48MG
LECITHIN, HYDROGENATED SOY	INHALATION; AEROSOL, METERED		Pending	0.28%
LECITHIN, HYDROGENATED SOY	INTRAVENOUS; INJECTION, POWDER, LYOPHILIZED, FOR LIPOSOMAL SUSPENSION		Pending	21.3%
LECITHIN, HYDROGENATED SOY	INTRAVENOUS; INJECTION, SUSPENSION, LIPOSOMAL		Pending	0.0958%
LECITHIN, SOYBEAN	INHALATION; AEROSOL, METERED	8030760	1DI56QDM62	0.1%

LECITHIN, SOYBEAN	ORAL; CAPSULE	8030760	1DI56QDM62	5MG
LECITHIN, SOYBEAN	ORAL; CAPSULE, SOFT GELATIN	8030760	1DI56QDM62	20MG
LECITHIN, SOYBEAN	ORAL; SUSPENSION	8030760	1DI56QDM62	0.2%
LECITHIN, SOYBEAN	VAGINAL; EMULSION, CREAM	8030760	1DI56QDM62	0.33%
PROPYLENE GLYCOL - LECITHIN	BUCCAL; PATCH, CONTROLLED RELEASE		Multiple	49.4MG
PROPYLENE GLYCOL - LECITHIN	ORAL; SOLUTION		Multiple	99.32%

Update Frequency: Quarterly
Data Through: September 16, 2013
Database Last Updated: October 24, 2013

Links on this page:

1. http://www.addthis.com/bookmark.php?u508=true&v=152&username=fdamain
2. http://www.addthis.com/bookmark.php
3. http://www.fda.gov/default.htm
4. http://www.fda.gov/Drugs/InformationOnDrugs/default.htm
5. http://www.fda.gov/Drugs/InformationOnDrugs/ucm080123.htm
6. http://www.fda.gov/Drugs/InformationOnDrugs/ucm075230.htm
7. http://www.fda.gov/Drugs/InformationOnDrugs/ucm075230.htm
8. http://www.fda.gov/Drugs/InformationOnDrugs/ucm075230.htm
9. http://www.fda.gov/Drugs/InformationOnDrugs/ucm075230.htm
10. http://www.fda.gov/Drugs/InformationOnDrugs/ucm075230.htm

Note: If you need help accessing information in different file formats, see Instructions for Downloading Viewers and Players.

U.S. Food and Drug Administration
10903 New Hampshire Avenue
Silver Spring, MD 20993
Ph. 1-888-INFO-FDA (1-888-463-6332)
Email FDA

Links on this page:

Clin Exp Allergy. 1998 Dec;28(12):1559-64.

Antigenicity of the proteins in soy lecithin and soy oil in soybean allergy.

Awazuhara H[1], Kawai H, Baba M, Matsui T, Komiyama A.

PubMed

Display Settings: Abstract

Full text links

DECKER

J Cutan Med Surg. 2008 Jan-Feb;12(1):27-30.

Type I hypersensitivity in an asthmatic child allergic to peanuts: was soy lecithin to blame?

Béliveau S[1], Gaudreault P, Goulet L, Primeau MN, Marcoux D.