FINAL REPORT ON THE SAFETY ASSESSMENT OF MINK OIL[1]

Mink Oil is obtained from the subdermal fatty tissues of the mink. The oil is a mixture of the natural glycerides of 14–20 carbon chain fatty acids. Mink Oil is used in cosmetic formulations as a hair conditioning agent, an occlusive skin conditioning agent, and as a surfactant. Current data on concentration of use is limited. A Mink Oil cream was noncomedogenic in rabbits following repeated (5 days a week for 2 weeks) applications, although minimal hyperemia and hyperplasia were noted at the treated site toward the end of the treatment. No sensitization was observed in animals treated with Mink Oil under occlusive patches, but sensitization was seen in animals treated with intradermal injections of Mink Oil in a maximization procedure. Mink Oil was not an ocular irritant in animals. Clinical studies done under occlusive patches found no irritation. In another clinical test, a rinse-off product containing 2.8% Mink Oil was applied to the skin for five consecutive days without rinsing. Some erythema was noticed, but in a repeat of the test, no erythema was seen. Mink Oil is reported to provide a minimal sun protection factor (SPF), but did not appear to increase the SPF when added to a solution containing recognized sunscreens. Studies using human volunteers indicate that Mink Oil applied to the skin remains on the skin surface. Additional safety test data are needed, including a 28-day dermal toxicity study, ultraviolet (UV) absorption data (and if the ingredient absorbs in the UVA or UVB region, then photosensitization data are also needed), and method of manufacture (extraction). Independent of these data needs, it is concluded that the total polychlorinated biphenyl (PCB)/pesticide contamination should not exceed 40 ppm with not more than 10 ppm for any specific residue. Because there are additional data needed in order to complete the safety assessment, the overall conclusion is that the available data are insufficient to support the safety of Mink Oil for use in cosmetic products.

CHEMISTRY

Definition

Mink Oil is obtained from the subdermal fatty tissues of the mink (Wenninger and McEwen 1997). The oil is a mixture of the natural glycerides of 14–20 carbon chain fatty acids; approximately 75% of the

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composition is 16–18 carbon chain fatty acid glycerides (Nikitakis and McEwen 1990).

Physical and Chemical Properties

Mink Oil is a pale yellow liquid with a mild characteristic odor. It is soluble in chloroform, carbon tetrachloride, ether, benzene, acetone, and isopropanol and is insoluble in water. The refractive index at 25°C is between 1.4665 to 1.4675. The freezing point is 5°C maximum; the saponification value is 190 to 220; the iodine value is 80 to 90 (Nikitakis and McEwen 1990). It has a specific gravity of 0.91437, a refractive index at 40°C of 1.4623 (SGS Control Services Inc. 1994). One source reports that because of its iodine value, Mink Oil "exhibits very low oxidation and degradation" (Emulan Inc., unknown date). Table 1 lists the acid composition found in Mink Oil Wax and crude Mink Oil.

Impurities

Analysis of one sample of Mink Oil found no detectable levels of the following PCBs, Arochlor 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

Table 1. Fatty acid composition of two mink oils

Acid	Carbon no.: unsat	Mink wax oil (% of total)	Mink crude oil (% of total)
Lauric	12	0.1	0.1
Myristic	14	4.0	3.5
Myristoleic	14:1	0.7	0.9
Pentadecanoic	15	0.2	0.1
Palmitic	16	28.0	17.2
Palmitic	16:1	13.3	17.0
Heptadecanoic	17	0.5	0.4
Heptadecanoic	17:1	0.6	0.5
Stearic	18	4.7	2.5
Oleic	18:1	35.3	40.9
Linoleic	18:2	10.6	15.0
Linolenic	18:3	0.4	0.6
Eicosanoic	20	0.1	—
Eicolenoic	20:1	0.7	0.6
Total unsaturated		61.6	75.5
Total saturated		37.6	23.8
Total		**99.2**	**99.3**

Unsat, unsaturated.
Source. Emulan, date unknown.

The assay had a minimum detection limit of 0.5 μg/l (New Jersey Laboratories/A.A. Labs Division 1995).

USE

Cosmetic

As shown in Table 2, as of January 1995, Mink Oil was reported to be contained in 139 formulations (FDA 1995). It is used in formulations as a hair conditioning agent, an occlusive skin conditioning agent, and a surfactant (Wenninger and McEwen 1997).

Concentrations of use are no longer reported to the Food and Drug Administration (FDA) (FDA 1992). Data from 1984 (FDA 1984) indicated

Table 2. Frequency of use of Mink Oil

Product category	No. formulations in category	No. containing mink oil
Bath oils, tablets, and salts	146	5
Other bath preparations	204	7
Mascara	211	2
Perfumes	260	1
Powders (excluding aftershave talcum)	290	1
Other fragrance preparations	158	1
Hair conditioner	693	10
Hair spray (aerosol fixatives)	348	5
Hair straighteners	59	2
Permanent waves	423	4
Shampoos (noncoloring)	916	5
Tonics, dressings, and other hair grooming aids	624	18
Other hair preparations	382	5
Face powders	305	1
Foundations	333	1
Lipstick	997	12
Shaving cream	152	3
Cleansing	771	12
Face and neck	261	2
Body and hand	987	11
Moisturizing	873	16
Night	220	4
Paste masks (mud packs)	276	2
Other skin care preparations	782	8
Suntan gels, creams, liquids	196	1
1995 totals		**139**

Source. FDA, 1995.

that mink oil was used in a variety of products at concentrations less than 25%. Data submitted directly to Cosmetic Ingredient Review (CIR) show Mink Oil to be used at 2% in self-tanning products and at 0.2% in hair products (CTFA 1995).

GENERAL BIOLOGY

Absorption

An Attenuated Total Reflectance–InfraRed Spectroscopy study was conducted to determine the penetration of a commercial preparation of Mink Oil into human stratum corneum. Five healthy Caucasian females were instructed to refrain from applying any topical agents to their forearms 24 hours prior to the study. A site on one forearm of each panelist was treated with 50 μl of the test substance. The same site on the other forearm was not treated and served as control. Both sites were scanned prior to product application. One hour after application, the treated site was again scanned. This was followed by scans of 5, 10, and 15 stripped layers. The same scans were conducted on the untreated sites. Scanning consisted of placing the subject's forearm directly onto a germanium plate and conducting an infrared (IR) spectra for wavelengths between 800 to 4000 cm^{-1}. The germanium plate served as an internal reflection crystal. Based on the IR spectra of the test substance, wavelengths of 1746, 1466, and 1163 cm^{-1} were chosen for analysis. Presence of Mink Oil in each of the four scans (surface, 5, 10, and 15 layers all done at 1 hour post-treatment) was defined as a greater absorbance value at the treated site versus the control. For each of the four scans, there were 15 absorbance pairs (a pair consisting of an absorbance value of the control and treated sites). Mink oil was detected at the surface scan of all panelists. It was detected within 5 layers in 4 of 5 panelists; in 10 layers in 2 of 5 panelists, and in 15 layers in 2 of 5 panelists. It was concluded that after 1 hour Mink Oil remains significantly on the skin surface (Xienta Institute for Skin Research 1988).

Comedogenicity

A Mink Oil cream was considered to be noncomedogenic following repetitive applications (ten applications in two consecutive weeks) to the external ear canal of six albino rabbits. Observations noted include "minimal to mild" hyperemia and "very minimal" hyperkeratosis in the treated areas of all animals towards the end of the treatment period (Wells Laboratories, Inc. 1990b).

ANIMAL TOXICOLOGY

Acute Oral Toxicity

A commercial preparation of Mink Oil had an oral LD_{50} of >64.0 cc/kg in albino rats (Bio-Toxicology Laboratories, Inc. 1974). In another study, a Mink Oil cream had an oral LD_{50} of >5.0 ml/kg (Wells Laboratories, Inc. 1990e).

Dermal Irritation

Patches containing 0.5 ml of a commercial preparation of refined Mink Oil were applied to intact and scarified areas of albino rabbits. The treatment areas had earlier been clipped free of hair. Animals were immobilized for a 24-hour period; the sites were evaluated at the end of the treatment period and 24 hours afterwards. Scores were made according to the Draize scale. No erythema or edema was noted (Leberco Laboratories 1972a).

Patches containing 0.5 ml of refined Mink Oil (neat) were applied to intact and abraded skin of six rabbits. No irritation was noted (Primary Irritation Index score 0.0) at observations made 24 and 72 hours after application (Wells Laboratories, Inc. 1979b). Similar results were reported by Wells Laboratories, Inc. (1990d) when a cream containing Mink Oil was tested on three New Zealand white rabbits using the same protocol.

Dermal Sensitization

Over a period of 20 days, eight male guinea pigs received ten subcutaneous injections of a 0.1% suspension of refined Mink Oil; the injections were administered to the clipped back and sides. The test material was suspended in physiological saline and was administered in 0.1-ml doses except for the first injection which contained 0.05 ml. Two weeks after the final induction injection, a test injection of 0.05-ml was administered. Reaction areas were measured 24 hours after each injection. Reactions were noted throughout the induction period. However, as the value for the challenge was "less than for the average of the ten original readings (after induction), it can be said that (Mink Oil) did not produce any sensitization in the guinea pig" (Leberco Laboratories 1972b).

Female Dunkin-Hartley guinea pigs were treated with Mink Oil using the Magnusson-Kligman Maximization Procedure. The procedure involves the following phases: induction, dose range, booster, and challenge. During induction, sites on the upper back were injected intradermally with 50% Freund's complete adjuvant; 5% Mink Oil in propylene glycol; and 5% Mink Oil in 50% Freund's complete adjuvant. Control

animals were injected with complete adjuvant, propylene glycol, and 1:1 propylene glycol in complete adjuvant. During the dose range phase, ten animals were tested with 24-hour occlusive patches containing 25, 50, and 100% Mink Oil. Sites were evaluated for irritation at 24, 48, and 72 hours after patch application. Two of the animals reacted to the 25% concentration with a response graded as "barely perceptible"; by 72 hours the condition cleared. These two animals also reacted to the higher concentrations of Mink Oil; the reactions cleared by the observation at 72 hours. Another four had "barely perceptible" or "mild" reactions to the 50% concentration. These reactions also cleared by 72 hours and three of these four animals did not react to the 100% concentration. Three animals reacted for the first time to the 100% concentration with a "barely perceptible" response (two also had desquamation); these conditions cleared by 72 hours. During the booster phase (one week after induction injections), undiluted Mink Oil was topically applied. As this concentration did not produce irritation in the dose range phase, 5% sodium lauryl sulfate (SLS) was applied to the induction site 24 hours before the booster. Control animals were pretreated with SLS before receiving a booster of undiluted petrolatum; positive controls were treated with 25% phenylacetaldehyde without SLS pretreatment. During the booster phase, all test and control animals were wrapped occlusively for 48 hours. Two weeks following the booster, test animals were challenged with a 24-hour occlusive patch of 25% and 50% Mink Oil in petrolatum. Reactions were scored at 48 and 72 hours after patch application. There were no reactions to 25% Mink Oil noted in the ten animals at the 48 hour reading; one animal had a "barely perceptible" reaction at 72 hours. Four animals had a "barely perceptible" and one had a "mild" response to 50% Mink Oil at the 48 hour reading. At the 72 hour reading, erythema was noted in 7 of 10 animals, which ranged from "barely perceptible" (4 animals), to "desquamation" (2 animals), and "mild with desquamation" (1 animal). The 50% Mink Oil in petrolatum was considered to produce a weak allergenic response (CTFA 1983).

The Buehler Technique was used by Wells Laboratories (1990a) in a guinea pig sensitization assay. During induction, nine occlusive patches containing 0.5 ml of a 50% dilution (in corn oil) of a Mink Oil cream was applied to the clipped back and flank of 10 animals. The patches remained for 6 hours of contact and readings were made at the time of patch removal and at the end of 24 hours. Positive controls were treated with dinitrochlorobenzene (DNCB). After a 2-week nontreatment period animals were challenged with two identical applications of the test material. One patch was applied at the site of induction, and the other on a previously unexposed site. Challenge patches were applied for 6 hours of contact and observations were made at the time of patch removal and at the end of 24 hours. A reading of "very slight" erythema was noted in

all animals during induction; "slight" erythema and "slight" edema were noted in positive controls. During challenge, no irritation was noted in animals of the Mink Oil group; marked erythema and very slight edema was noted in animals of the positive-control group.

Ocular Irritation

A commercial preparation of refined Mink Oil (0.1 ml) was instilled into the right conjunctival sac of three albino rabbits. The untreated left eye served as control. Eyes were evaluated every 24 hours for four days and then again on the seventh day. Scores were made according to the Draize scale. No irritation was noted (score 0) (Leberco Laboratories 1972c). Another ocular irritation test was conducted using three rabbits and the above described protocol (Wells Laboratories 1979a). Undiluted Mink Oil (commercial preparation, dose not reported) did not produce any observable irritation. A Mink Oil cream (0.1 ml) was applied to one eye of each of three New Zealand white rabbits. The contralateral eye was not treated and served as control. Eyes were unwashed for 24 hours and observations made 24, 48, and 72 hours after treatment. No irritation was noted (Draize score 0.01) (Wells Laboratories, Inc. 1990c).

CLINICAL ASSESSMENT OF SAFETY

Dermal Irritation and Sensitization

Twenty panelists received a single 24-hour occlusive patch containing a 25% aqueous dilution of a hair-rinse containing 3% Mink Oil (effective concentration of mink oil tested: 0.75%). No reactions were noted in 16 panelists, reactions of ± (the mildest nonzero score possible) were noted in four panelists. The Primary Irritation Index (PII) was 0.10 out of a maximum possible score of 4.0 (CTFA 1989). Identical results were reported in a second patch test study in which a formulation containing 2.8% Mink Oil was tested at full-strength in 20 panelists (CTFA 1992a). A third human patch test study reported a PII of 0.08 after 19 panelists were tested with a (full-strength) formulation containing 2.8% Mink Oil (CTFA 1993).

A four-day minicumulative patch test of a body spray containing 1% Mink Oil had a PII of 0.50. Of 20 panelists, 5 had no response, 12 had a "barely perceptible" response, 2 had a "mild" response, and 1 had a "moderate" response (CTFA 1991).

In an exaggerated-use study, 19 female panelists applied to the lower arm a rinse-off hair product containing 2.8% Mink Oil once a day for 5 days with no rinse off. A commercially available rinse-off hair product

was applied to a different site to serve as a reference. Four subjects experienced some transient mild to moderate erythema (CTFA 1992b). In a second study using the same protocol, no clinical responses were observed in 24 females who also tested a rinse-off hair product containing 2.8% Mink Oil (CTFA 1994).

Sun-Protection Factor

Wells Laboratories (1988a) tested the sunscreening ability of Mink Oil using a modified version of the procedure described by FDA (1978) for evaluating the sun protection factor (SPF) of sunscreens (the modification involved use of less than the prescribed 20 subjects). The solutions tested contained Mink Oil in various concentrations with Octyldimethyl *para*-aminobenzoic acid (PABA) and isopropanol. Using six subjects, it was observed that 20% Mink Oil with 3% Octyldimethyl PABA and 77% Isopropanol has an "SPF value equal to that of a solution using the same amount of active ingredient." This SPF value was 5.36. Details and the specific light source used were not reported.

In an earlier study, a commercial preparation of Mink Oil had an SPF value of 2.2. The undiluted solution was tested on five healthy fair-skinned persons with skin types characterized as very sensitive, sensitive, or normal (Wells Laboratories 1988b).

SUMMARY

Mink Oil, obtained from the fatty tissues of minks, is a mixture of the natural glycerides of 14–20 carbon chain fatty acids. As of January 1995, it was reportedly used in 139 cosmetic formulations as a hair conditioning agent, an occlusive skin conditioning agent, and as a surfactant. In 1984 FDA data, Mink Oil was used at concentrations of 25% and less (1995 data from the cosmetics industry indicate use at $\leq$2% in two product types).

An Attenuated Total Reflectance–InfraRed Spectroscopy study found that 1 hour after application, Mink Oil was detected on the skin surface of all 5 panelists; it was detected within the stratum corneum in 2 of 5 panelists.

Mink Oil has an oral LD_{50} of >64.0 cc/kg in albino rats.

No erythema or edema was noted after refined Mink Oil was applied for 24 hours to intact and scarified area of albino rabbits. Although reactions were noted during induction, a 50% dilution of a Mink Oil cream did not sensitize guinea pigs using the Buehler technique. In a second study, using the Magnusson-Kligman Maximization Procedure, 50% Mink Oil in petrolatum induced sensitization reactions. Mink Oil was not an ocular irritant to albino rabbits.

Clinical studies using single occlusive patches found no irritation with up to 2.8% Mink Oil (PII scores of 0.08–0.10). Transient mild to no irritation was noted in two exaggerated-use studies.

DISCUSSION

Section 1, paragraph (p) of the CIR Procedures states that "A lack of information about an ingredient shall not be sufficient to justify a determination of safety." In accordance with Section 30(j)(2)(A) of the Procedures, the Expert Panel informed the public of its decision that the data on Mink Oil were not sufficient for determination whether the ingredient, under relevant conditions of use, was either safe of unsafe. The Panel released a Notice of Insufficient Data on March 17, 1995, outlining the data needed to assess the safety of Mink Oil. Comments were received during the 90-day public comment period. Additional data needed to make a safety assessment are:

1. 28-day dermal toxicity;
2. UV absorption data; if the ingredient absorbs in the UVA or UVB region, then photosensitization data are also needed; and
3. method of manufacture/extraction.

In the event that the above data are received and are sufficient to complete the safety assessment, the CIR Expert Panel will limit the total PCB/pesticide contamination to not more than 40 ppm with not more than 10 ppm for any specific residue. These limitations are modeled after the United States Pharmacopeia standards for Lanolin (USP 1995).

CONCLUSION

The CIR Panel concludes that the available data are insufficient to support the safety of Mink Oil for use in cosmetic products.

REFERENCES

Bio-Toxicology Laboratories, Inc. 1974. Acute oral LD_{50} toxicity study on emulan oil of mink. Unpulished data provided by CTFA, 3 pages.*

Cosmetic, Toiletry, and Fragrance Association (CTFA). 1983. Mink Oil: Modified Magnusson-Kligman Guinea pig maximization test for contact sensitization. Study project: GPA-07-83 B. Unpublished data provided by CTFA. 17 pages.*

CTFA. 1989. Clinical evaluation report: Human patch test; Mink Oil. Unpublished data provided by CTFA, 1 page.*

*Available for review from Director, Cosmetic Ingredient Review, 1101 17th Street, NW, Suite 310, Washington, DC 20036 USA.

CTFA. 1991. Four-day mini-cum patch test results; Mink Oil. Study Ref #: 731-91. Unpublished data provided by CTFA, 1 page.*

CTFA. 1992a. Clinical evaluation report: Human patch test; Mink Oil. Unpublished data provided by CTFA 1 page.*

CTFA. 1992b. Irritancy potential; Mink Oil. Unpublished data provided by CTFA, 4 pages.*

CTFA. 1993. Clinical evaluation report: Human patch test; Mink oil. Unpublished data provided by CTFA, 1 page.*

CTFA. 1994. Evaluation of hair improvement; Mink oil. Unpublished data provided by CTFA, 3 pages.*

CTFA. 1995. Use levels for various ingredients. Unpublished data provided by CTFA 1 page.*

Emulan, Inc. Unknown data. Information on the stability of Mink Oil with storage and acid content of two grades of Mink Oil. Unpublished data provided by CTFA, 2 pages.*

Food and Drug Administration (FDA). 1978. Sunscreen drug products for over-the-counter human drugs. *Federal Register* 43:38206–38269.

FDA. 1984. *Cosmetic product formulation and frequency of use data.* [FDA database.] Washington, DC: FDA.

FDA. 1992. Modification in Voluntary Filing of Cosmetic Product Ingredient and Cosmetic Raw Composition Statements. Final rule. *Federal Register* 57:3128–3130.

FDA. 1995. *Frequency of use of cosmetic ingredients.* [FDA database.] Washington, DC: FDA.

Leberco Laboratories. 1972a. Dermal irritation assay on guinea pigs: New process Emulan™ multi-refined oil of mink. Assay no. 23872. Unpublished data provided by CTFA, 2 pages.*

Leberco Laboratories. 1972b. Dermal sensitization assay on guinea pigs: New process Emulan™ multi-refined oil of mink. Assay No. 23873. Unpublished data provided by CTFA, 4 pages.*

Leberco Laboratories. 1972c. Ocular Irritation assay on rabbits: New process Emulan™ multi-refined oil of mink. Assay No. 23871. Unpublished data provided by CTFA, 4 pages.*

New Jersey Laboratories/ A. A. Labs Division. 1995. Results of analysis of Mink Oil for PCB's. Assay No. 25583. Unpublished data provided by CTFA, 1 page.*

Nikitakis, J. M., and G. N. McEwen, Jr. ed. 1990. *CTFA compendium of cosmetic ingredient composition—Descriptions I.* Washington, D.C: CTFA.

SGS Control Services Inc. 1994. Sample identification. Unpublished data provided by CTFA, 1 page.*

U.S. Pharmacopeia. 1995. *The United States pharmacopeia: The national formulary.* 23rd rev, 869–871. Rockville, MD: United States Pharmacopeial Convention, Inc.

Wells Laboratories, Inc. 1979a. Report on eye irritation testing in rabbits: Multi-refined oil of mink. Lab No. H-7676. Unpublished data provided by CTFA, 2 pages.*

Wells Laboratories, Inc. 1979b. Report on primary skin irritation on rabbits: Multi-refined oil of mink. Lab No. H-7677. Unpublished data provided by CTFA, 2 pages.*

Wells Laboratories, Inc. 1988a. Report on a comparative study of the sun protection factor determination screen employing a mink oil mixture with octyldimethyl PABA. Lab No. L-4730A. Unpublished data provided by CTFA, 4 pages.*

Wells Laboratories, Inc. 1988b. Report on sun protection screening test using oil of mink. Lab No. L-4730. Unpublished data provided by CTFA, 2 pages.*

Wells Laboratories, Inc. 1990a. Report on guinea pig sensitization test: Emulan sable cream. Lab No. W90-992. Unpublished data provided by CTFA, 10 pages.*

Wells Laboratories, Inc. 1990b. Comedogenic assay: Emulan sable cream. Lab No. W90-994. Unpublished data provided by CTFA, 6 pages.*

Wells Laboratories, Inc. 1990c. Report on eye irritation testing in rabbits: Emulan sable cream. Lab No. W90-990. Unpublished data provided by CTFA, 3 pages.*

Wells Laboratories, Inc. 1990d. Report on primary skin irritation in rabbits: Emulan sable cream. Lab No. W90-991. Unpublished data provided by CTFA, 3 pages.*

Wells Laboratories, Inc. 1990e. Report on acute oral toxicity: Emulan sable cream. Lab No. W90-993. Unpublished data provided by CTFA, 2 pages.*

Wenninger, J. A., and G. N. McEwen, Jr. ed. 1997. *International cosmetic ingredient dictionary and handbook*. 7th ed, 822. Washington, DC: CTFA.

Xienta Institute for Skin Research. 1988. Infrared penetration study for Emulan Incorporated. Study No. BM-01-88. Unpublished data provided by CTFA, 19 pages.*