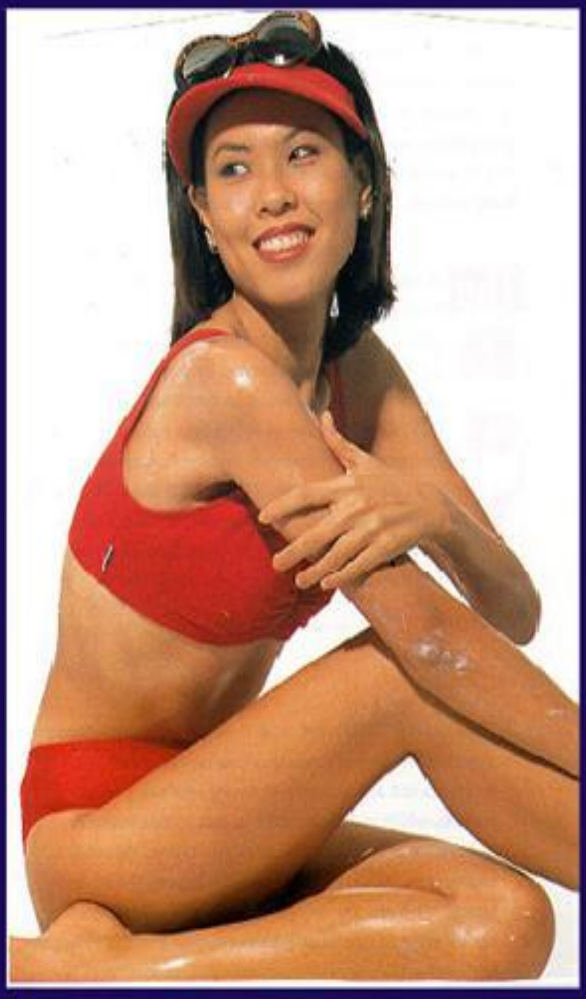
TANNING

without intending to be in the Sun



Sunless Self Tan Plant Actives

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CAMPO® Multi-Purpose Cosmetic Base Chemicals & Active Ingredients

CAMPO® Novel Functional Active Cosmetic Ingredient & Raw Materials

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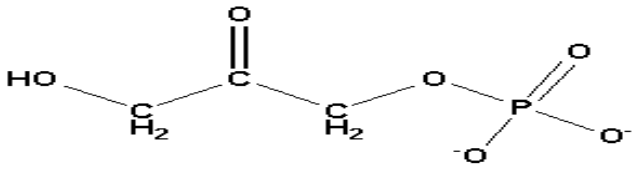
MAHAKANNI SELF-TANNING LIPOSOME CONCENTRATE ECLIPTA ALBA

There are, broadly speaking, three classes of functional extracts from Mahakanni herb ***(Eclipta Alba).*** These are **Maka, Mahakanni, Mahakanni STLC.**

This paper concentrates on the functionality of Mahakanni STLC and its UV absorption components. These components are complex in nature and the action of Mahakanni relies not solely on the direct action of these components, but on their ability to react safely with components of the skin to produce an excellent and efficient self-tanning agent. It is the result of the reaction of the components of Mahakanni with the skin that results in its excellent UV protection properties. In this respect, this interactive extract of Mahakanni is similar in function to synthetic dihydroxyacetone, and other natural examples of similar functionality being natural henna and natural *Sepia officinalis* (squid), natural Black Walnut Shells and natural octopus pigments

The important components of Mahakanni STLC are DHAP (2-hydroxy-1, 4-DHAP), and phyto-eumelanin, a plant novel black brown natural pigment, of Mahakkani leaf which is identical to the natural skin pigment. This totally natural occurrence of Phyto-Eumelain in the leaves of Eclipta alba, should not be confused to claims of GMOs. This is a natural plant pigment of Eclipta alba.



Dihydroxyacetone Phosphate (DHAP)

The self-tanning properties and functionality of Mahakanni STLC are a result of the reaction of natural DHAP (Dihydroacetone Phosphate) with the skin. This is further enhanced by the natural phyto-eumelanin in a similar totally natural reaction with keratin protein which is present in the surface of the skin. This reaction of phyto-eumelanin binding to the keratin protein is identical to the final stages of melanogenesis, the forming of darker skin after initial exposure to UV-A radiation, and absorption of UV-A and UV-B. The combination of DHAP and phyto-eumelanin form the respective scleroDHAP and scleraeumelanin compounds which are both red-brown in colour and have total UV absorption properties. These products are a result that is similar to the well documented Maillard et Browning reaction sequence. This is also similar to the reaction with commercially available synthetic DHA (1.3-Dihydroacetone), but natural DHAP's novelty lies in the red-brown natural colour that is given, rather than typical unsightly yellow colour exhibited following the reaction of synthetic DHA with keratin proteins.
An important aspect of natural, yet still un-commercialized DHAP, is that natural DHAP as is very unstable in normal room ambient temperature and may convert to natural DHA.This natural DHA may show up in HPLC assays of this natural plant extract, up to 55% v/v, and is very confusing to the Analytical Chemists who may assume this natural DHA component as synthetic DHA.

The other unique point is the presence of natural ascorbic acid in Mahakanni STLC which further reacts with DHAP to produce hydroDHAP, which is also a recognised UV absorber. Also in the extract is the presence of complex lipids, such as phosphoglyceride derivatives, the glycerophospholipids, glycerophosphates and phosphosphingolipids and the new, novel sphingomyelin, which almost certainly will spawn the next generation of therapeutic claims in the cosmoceutical industry within the next two years. Sphingomyelin reacts with the horny layer of the skin, forming a biological barrier film, which functions to tighten and firm loose skin and reduce trans epidermal moisture loss. Thus, when Mahakanni STLC is applied, a subtle tightening of the skin is felt, moisture loss is minimised through the action of this film which serves to reduce the convection of UV rays, i.e., the natural evaporation of skin moisture caused by high UV transmittance and absorption.

MAHAKANNI STLC

Mahakanni self-tanning liposome concentrate is an extract from *Eclipta Alba* and brings about natural tanning of the skin, giving a particularly even and natural tan when compared to synthetic dihydroxyacetone (DHA).

The active principle of the tanning action is DHAP, (2-hydroxy-1, 4-DHAP) and their derivatives in addition to β-carotene, in a liposomal form which is water soluble.

The DHAP bonds firmly to the horny layer of the skin, showing a distinctive bronzing, with the ultimate effect in sun protection. This product exhibits a much quicker and longer lasting tanning action than synthetic DHA.

SPECIFICATION

Product Name Other Trade Name	*Mahakanni self-tanning liposome concentrate extract* ***Campo Mahakanni***
Product #	*95130-3003 MA*
INCI Name	*Eclipta prostata extract*
Specific gravity	*1.010 – 1.520*
Refractive index	*1.400 – 1.500*
pH (in 10% Water Solution)	*1.0 to 3.5*
Extraction Solvent Extraction Menstrum	*Carbon Dioxide gas (100%)* *Water (<1%)*
Colour	*Light Yellow to Light Yellowish Brown Highly Viscous liquid*
Solubility Application Dosage level Applications:-	*Soluble in water,* *1 to 15 %* *Sunless Self Tanning creams, lotions, and aerosol sprays, Bronze Foundation creams, Hair Color and Hair Bronzing product Face & Body and Bronzing creams*
Preservative	*None*
Pesticides	*None*
Microbiology	*<100 cfu/g (no pathogenic bacteria)*
Application level	*1 to 15%*

COMPOSITION

Components (partial list)	**%**
Natural DHAP	40.00
Phyto-eumelanin	50.00
Ascorbic acid	1.50
Glycerophospholipids	3.00
Phosphosphingolipids	2.50
Sphingomyelin	1.50
Beta-carotene	0.50
Thiamine	trace
Malic acid	trace
Niacin	trace
Catalyase Enzymes	1000 units

MAHAKANNI SELF TANNING LIPOSOME CONCENTRATE

Mahakanni self-tanning liposome concentrate is an extract from Eclipta Alba that brings about a natural tanning of the skin, giving a particularly even and natural tan when compared to synthetic dihydroxyacetone (synthetic DHA). The tan develops quicker and is longer lasting.

Generally as an organic grown plant product, Mahakanni STLC extract is safer to use than synthetic DHA.

DOSAGE & APPLICATION

Mahakanni STLC may be added to the aqueous phase of emulsions, preferentially oil in water type. Liquid preparations in an aqueous form with 30% alcohol are normal.

An even application to the skin is important. Before applying the finished self-tanning preparation containing Mahakanni STLC, the skin should not be treated with creams or make-up preparations. The use of a face-mask before application of the self-tanning preparation improves the effect. The tanning effect is apparent approximately 3 hours after the application but to intensify the effect a further treatment should be repeated 2 or 3 times with an interval of 1 hour between each application. After application of the self-tanning formulation, one should not wash for approximately one hour. However, if the preparation has been split on hands or fingers, it should be washed off immediately with soap and water.

Generally a cheap variety of natural label claim cosmetics (as is the current cases were) are be formulated using the following combinations:.. However We, at Campo as manufacturer, **do not recommend such type of Label Claims**, **but to use at Dosage Levels 5% to 6.5% as a lone natural Tanning ingredient of our Mahakanni STLC**.

Synthetic Dihydroxyacetone	3% (dissolved in water at 38°C)
Mahakanni STLC	4%
Or	
Synthetic Dihydroxyacetone	4%
Mahakanni STLC	2%

Both synthetic DHA and Mahakanni STLC are dissolved in water. The temperature should not exceed 38°C for any length of time.

CAUTION

As synthetic DHA causes formation of nitrosomes when applied on the skin, Campo does not recommend such False Label Claims, due formation of nitrosomes when synthetic DHA is used. This is a suggestion to point out of the general trend, however, we do not recommend the use of synthetic dihydoxyacetone with any of our Campo ingredients.

STORAGE:

The Mahakanni STLC should be stored at 4°C in a refrigerator, in dark containers that are well closed and airtight.If required, the Mahakanni STLC can be stored or transferred into dark or dark amber glass bottles protected from direct sunlight. After prolonged storage of Mahakanni STLC, we recommended shaking or stirring the contents.

SUNLESS SELF TAN EMULSION

WHY THE NEED FOR SUNLESS SELF-TAN EMULSION WITH NATURAL PLANT SELF-TANNING EXTRACT ???

Suggested Formulary for a Novel Self-Tan Emulsion	
Glyceryl stearate	2.50
PEG - 100 Stearate	2.50
Sorbitan Stearate	3.00
Polysorbate 60	3.00
200 Silicone fluid 100cs	0.50
Cetyl alcohol	1.00
Heavy liquid paraffin	3.00
Cetyl ester	2.00
Botanical oil/Campo Thulasi Ashvini root oil	2.00 Natural Novel UV A & B Filter
Botanical Extract/Campo Puruf Grande extract	0.50 Natural UV Filter
Water deionised	61.00
Sclerotium Gum / Camigel 1	0.50
Butylene glycol	3.00
Botanical Extract / Campo Mahakanni STLC	15.50

Dinucleotide Tanning (Sunless Tanning) products account for 20% of the suncare market and are the fastest growing segment. The main ingredient being synthetic Dihydroxyacetone (SYNTHETIC DHA), a dye that imparts a slightly orange, uneven coloration to the skin and synthetic DHA's monomeric form reacts with the amines of the skin resulting in the formation of high levels of N-nitrosamines -NDMA, NMOR & NMEA and its precursor TTA. These Nitrosamines then are absorbed into the skin and subsequently into the blood circulation. Nitrosamines are previously determined to be incidental in various types of cancers.

Now, a new novel way of DINUCLEOTIDE sunless tanning – with safe, natural looking tan (instead of synthetic DHA based products) -- is possible (WITHOUT synthetic DHA) from **Mahakanni STLC and Thulasi Ashvini Root Oil** - a novel emulsion that grew out of the studies/work at the molecular level to understand what causes tanning. ***Please see the Suggested Formulary for Sunless Self-Tan Emulsion.(below)***

When sunlight's UV strikes the skin, pieces of DNA weld together to form pyrimidine dimers, which are snipped by excision repair enzymes. this repair process triggers melanocytes to synthesize melanin, the pigment that tans the skin naturally. Pyrimidine dimers containing pTpT (dithymidylic acid 1,2/ a thymine dinucleotide) segments preferentially accumulate during the repair process.

Sunless Self-Tan Emulsion with Mahakanni STLC and Thulasi Ashvini Root Oil contain pTpT, DHAP (2-hydroxy-1,4-DHAP) and its sclero-derivatives, , and phyto-eumelanin and its sclero-derivatives (a natural skin like plant pigment found in Eclipta prostrata herb's genes) as natural isolate(s) extracted and constituted in Mahakanni STLC (a bio-tech extract from Eclipta prostrata herb). This novel self-tan emulsion further contain Thulasi Ashvini Root Oil (Basilicum sanctum radix oleo) - a novel advanced biotech oil extract which is rich in contents of natural 'phyto T4 endonuclease V', (a plant-sourced pseudo 'T4N5 enzyme and other similar functional enzymes) that are involved in absorbing UV from the skin's surface, then enzymatically convert the energy to repair and restore skin's DNA damage.

Generally, plants, fishes, and frogs have the same protective mechanism well-developed for genoprotection from tremendous amount of ultraviolet, but not humans. When sun's UV rays
strikes a human skin DNA, the body recruits DNA excision repair enzymes to mend the destruction. These enzymes recognise damaged DNA, remove the damage strand, and use the healthy DNA strand as a template to rebuild a matching piece and activates genes like p53 which co-ordinates apoptosis 3 (normal programmed cell death) to remove damaged cells (in the healing) which appear as peeling, dry skin after a sunburn, but such mending is never complete (comparing a human's mechanism to a plant's well-developed mechanism of genoprotection), and develop into as actinic keratosis (precancerous sunspots) or further develop into disfiguring squamous cell carcinoma; and maybe to be a more deadlier melanoma skin cancer, as wounded cells accumulate.

Phyto-pseudo T4N5 enzyme from Thulasi Ashvini Root Oil has the similar functionality to T4N5 enzyme (in liposome formula) currently under investigation in Phase III trials as treatment the rare genetic disease Xeroderma pigmentosum (XP) or albinism. XP patients are extremely sun-sensitive and develop skin cancer early, due to the lack of the DNA repair mechanism. Thulasi Ashvini Root Oil's phyto-pseudo- T4N5 prevents sunburn, speed-up DNA repair and prevents UV-induced immunosuppression (the additional risk factor for development of skin cancer 4).

Literature References:

1. M. Eller et al., Nature, 372:413-4, 1994
2. M.S. Eller et al., Proceedings of the Nat'l Acad. of Sciences, 93:1087-92, 1996
3. A. Ziegler et al., Nature, 372:773-6, 1994
4. A. Jeevan M.L. Kripe, Lancet, 342:1159-60, 1993

Q: Are nitrosamines in cosmetics a health hazard?

A: The nitrosamine of primary concern is N-nitrosodiethanolamine (NDELA). For many years the FDA has analyzed surveillance samples of cosmetics, principally those containing DEA and TEA, for NDELA. The levels of NDELA detected has ranged from less than 30 parts per billion to 150 parts per million.

FDA has urged cosmetic manufacturers to voluntarily remove from cosmetic any ingredient which may combine with others to form NDELA and to conduct additional testing to determine why cosmetics become contaminated with NDELA.

Information currently available does not indicate that NDELA, at the levels detected in cosmetics, is a health hazard.

Source: Excerpted from a response to a 1992 consumer inquiry prepared by a staff person in the Office of Cosmetics; updated November 1996.

TANNING WITHOUT BEING IN THE SUN

When you start your summer skin care shopping, add sunless tanning products to your list. You can get a golden tan in minutes without risking sun damage. Are these sunless products Safe and do they work effective to absorb UV or repair UV damaged Skin DNA I interviewed across the globe for an answer to report to you on the scare (caused by DHA) mentioned in our largest daily, early this spring.

By L. Hashimoto, an international jetset scientific writer who resides in Tokyo, and writes regularly for Japan Consumering Public Health News, on legal and scientific events at MOHW and how these benefits the consumering public in Japan, in terms of safety and quality.

Your dermatologist's dream has finally come true. Now patients can sport a tan without sun damage to their skin. In the last few years, safe and effective sunless tanning agents have appeared in natural products stores across Japan, eliminating the bake, burn, wrinkle and wasted time associated with sitting in the sun.

The active ingredient in sunless tanning products is (has been) synthetic dihydroxyacetone, DHA, which is a USA Food and Drug Administration-approved colorless dye, but in our country Japan, synthetic DHA is under safety review in the light of new findings of nitrosamines formation by our MOHW (Ministry of Human Health and Welfare).

Chemically, synthetic DHA is a crystalline white powder made of a three-carbon sugar, which stains skin a light brown when it reacts with amino acids that occur naturally in skin cell proteins.The synthetic DHA based sunless tan products may also contain walnut juice extract, which acts as color control, says a Campo consultant, who is also clinical professor of dermatology at the University of Kyoto.

Campo Representative in Paris Mrs Jarrouse says that sunless tanning products are a great alternative. It's a safe way to tan with a milky white emulsion which actives are herb total extract like Mahakanni STLC and Thulasi Ashvini Uvzymes rather than with messy dark colored product composed of industrial by-product like synthetic DHA; and it's so silly to go out and get tan in the sun, she says.

How do these products work? Synthetic DHA forms a caramel-like substance with the stratum corneum, or the uppermost layer of the skin, and creates a color which varies from person to person, Of course, the current concern / worry of nitrosamines formation exist for DHA based sunless tanning, the Campo consultant says.

Another independent consultant who was interviewed, who is also a clinical professor of dermatology at the University of North Carolina (USA), has conducted research on sunless tanning products and other novel alternatives such as Mahakanni STLC - a neat biotechnological Eclipta alba Linn,-non-GMO whole herb extracted Sunless tanning agent and nucleotides.

Theoretically until now-at present in USA and Europe, synthetic DHA is considered safe to use because as it appears to work only in the uppermost skin layer, claimed to be avoiding other organs (USA-based - Journal of the Am. Acad. Of Dermatology, 1992, vol.27) but however, a few Japanese -based Cancer Institutes- in a still ongoing investigative research work - yet to be published studies (interim reports released) are contradicting the present safe use of synthetic DHA. These studies suggest affirmatively that the monomeric form of synthetic DHA can react with the amines of the skin to form nitrosamines that are highly substantive and absorbed rapidly into the skin and then into the blood circulation and later, found deposited in the vital organs like the liver and kidneys, the second independent consultant interviewed says.

However, dermatologists warn strongly that despite a temporary tan, the chemical color won't protect you from ultraviolet sun damage. Be aware that while your skin may look tan, it will have no protection from the sun, says David Alkek, M.D.., a dermatologist and spoke-person for the American Academy of

Dermatology (USA). Most self-tanning creams contain little or no sun protection factors (SPFs), so always use a sunscreen before going out, even though your skin may appear to be tan.
Alkek says there's another method of sunless tanning that's not safe tanning pills. Not only are these pills dangerous, they're illegal in this country, he says. Canthaxanthrin, a chemical relative to beta-carotene, is tanning pills' active ingredient. Some manufacturers list this as their main ingredient, trying to make it sound safe.

Unlike older chemical skin dyes, which turned some people's skin orange, even green, the current crop of sunless tanning products shouldn't rub off on your skin or clothes, except for certain types of raw silk and wool, which have the same chemicals as the epidermal layer of skin, says Linda Newton, a spoke-person who represents another USA manufacturer (a cosmetic division of a large USA drug firm) of these tanning creams based on Mahakanni STLC and UVzymes, we have interviewed. If your skin is completely dry before you dress, it shouldn't be a problem, she adds.

Rapid results are what Newton likes most about Mahakanni STLC based emulsion creams sunless tanning. One night I had a party to go to and wanted to wear a sleeveless dress. Within 1 hour my arms were tan. It was quick fix without damage and without messy dark-colored products, Newton says.

Just like the sun-baked version tan, a novel emulsion cream tan from a bottle will fade away, but in about three weeks later completely, as the outer layer of skin sloughs off. Users can apply the cream as often as they want, but once every few days should be enough to maintain color. Newton says, These products are real time savers. There's nothing good about lying in the sun. It's harmful, you don't get aerobic exercise and you get hot. I can think of other things I'd rather do with my time.

Recently new sunless tanning products have come out in sprays, which help spread the synthetic DHA more evenly and hard to reach places on your body. Some newer versions also contain alpha-hydroxy acids (AHAs), the skin peeling agents in many moisturizers that smooth lines and soften skin. You have to have nice skin to have a nice tan. I know people who use sunless tanning products as a night cream twice a week, so they don't need foundation, Newton says. You don't have to worry anymore about kissing someone or putting your head on their shoulder and having the color on your face rub off, she adds. Alkek concludes, Why work on a 'real' tan, risking premature wrinkling and skin cancer, when in a few hours you can get an even tan without the risks?

JAPANESE WOMEN DON'T SUN BATHE

Scientists at Campo Research Labs., at Kyoto, Japan have found a way to produce a real tan without the sun's help. By stimulating production of melanin pigment in the skin of non-Biotechnological guinea pigs and Biotechnological mice (Campo blue diamond ™) with human skin, researchers were able to darken the animals' skin.These results were re-produced in 1,000 Japanese teenagers (age 13 -19) in Yokohama, two summers ago, and similarly three winters ago-450 middle-aged (age 40-66) skiers and climbers in Mount Fuji area for protection against snow reflected UV and tanning the ski-goggles white-areas around the eyes (white-areas after removing the ski-glass) were tested as the teenagers in Summer 94 were.

The result of the human volunteers' finding is the Sun-Off Self-Tanning Milk-an emulsion with various SPF values from SPF 8 to 45, which is now rated as the first most prized self-tanning product for all seasons, in 21,000 departmental stores and 1,200 health food outlets, across Japan as most of you are familiar with the advertisements and the sexy sunny bottles in the stores - as seen on tv after the weather reports, as you the conventional Japanese women, would not dream of messing your body with dark colored tanning products or sun-baking yourselves, as our younger generation Japanese who are always ready to sun-bake or make a fashion statement on their skins and hair with colors of the rainbow . This novel white emulsion for sunless tanning in your homes may be of help. Our kids are also becoming aware of the harms of being

sun-baking under our sun and SUN-OFF seems to be in every kids pocket as a trendy item like a hairbrush or comb is.

The findings came from Campo's parent (Kyoto-based Branch R&D Facilities) drug firm researchers' observations that tanning is an end product of the body's effort to repair damage skin cells caused by ultraviolet (UV) rays. UV rays force genes to fuse together, causing mutations that can result in cancer. In response, the body sends out gene-repair enzymes to destroy and replace the damaged gene fusions. These enzymes are called to action by the appearance in skin of gene cell fragments often present when UV damage occurs.

These enzymes do more than just absorbs the UV from human skin and converts the energy to repair the UV damage of genes. They stimulate cells to produce melanin, thus darkening skin and activate the p53 (Molecule of the Year 93) activity to prevent cancerous and UV-mediated immunosupression outcome, says Dr Balasubramaniam M, Ph.D., at Campo Research International Marketing Division

(Singapore) for Campo Active Cosmetic Ingredients and UVzymes. He says 'We expressed these human skin identical enzymes (non-GMO) which we collectively call by the trade name 'Uvzymes ™ from non-GMO classical Biotechnological Ocimum sanctum or the 'Thulasi Ashvini' herb root cells' instead of E.coli or other bacteria and the UVzymes™ are stable in a novel protein matrix carrier.

He further added that similarly, we also have done successful work on these human skin identical enzymes - as a high heat stability as well a highly compatible in reactions with other cosmetic and pharmaceutical ingredients - 'UV-Extremozymes™',-enzymes that are expressed from Methanococcocus and Thermus aquaticus (micro-organisms) which habitat is the non-oxygen, extreme heat sulfurous thermal-vents in the Pacific Ocean trench, near Japan and Guam. These concepts are already in use in high heat Enzymes for Polymerase Chain Reaction (PCR) techniques and Japanese manufacture of specialty detergents.

So Campo is positively ready with the active novelties Uvzymes and UV-Extremozymes for protection from solar UV rays-for the Sunscreens and Self-Tanning manufacturers to capitalize on the world-wide implementation of the UV Exposure Index which is very imminent soon. As our parent company in Japan has already have 1,209 patents worldwide for various versions of Uvzymes and UV-Extremozymes for textile dyes for clothes that will be filtering and absorbing solar UV, he finally added as a closing statement of our interview in his native city of sunny tropical Singapore, which will be adding the UV Exposure Index to its weather reports soon, as all Asean member countries will be doing so collectively, very soon with help our Space Agency.

Editors' Note:

UV Exposure Index is already introduced in our country nation-wide since 1994 and in the USA (53 cities but as experimental basis) since 1992.
So when you intend to go out - check out the UV Exposure Index in your city, as you would do with the weather, as our Space Agency is spending vast sums of tax-payers' money to inform the weather radio-stations of the UV fallout levels at noon each day in each of our

Japanese cities.
Transliteral translation via Toshiba Auto translator from Kanji to American English; of May 1996 issue of MOHW's Japan Consum
ering Public Health News (in Japanese Kanji text)

MOLECULE OF THE YEAR: *Protein p53*

Phyto-pseudo-p53™ liposomes (ex- non-GMO Biotechnological vegetable sources)

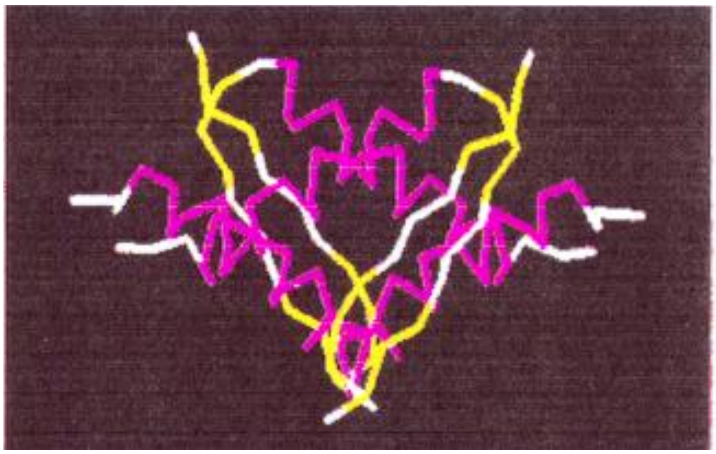
This ingredient is designed for natural Phyto (one-cell-marine miro-organism plant green bio-mass) gene-replacing in 'morning -after sunburn treatment'; designed to prevent sunburn from turning lethal. This ingredient is for treatment cosmetic targeted at squamous cell carcinoma, which involves the tumor-supressor gene p53. Squamous cell carcinoma although not deadly, disfigures and can kill if not removed quickly.

Precancerous sunspots, called actinic keratosis, progress to squamous cell carcinoma. P53 genes co-ordinates apoptosis (normal programmed cell death) to remove damaged cells, which appears as peeling or dry skin after sunburn. Sometimes more often than not, due to high solar UV fallouts caused by Ozone holes in the sky, these UV radiation zapped the p53 itself into mutations that garbles apoptosis signals, and cells with damaged and faulty DNA instead of sloughing off survived to become cancerous. 75% of actinic keratosis cells removed are likely to contain such mutations in p53.

Phyto-p53 liposomes is designed (for genetic injury-p53 mutations) to be incorporated ia a cream that functions to reconstitute and supplement the p53 protein and to prevent skin- cancer in "morning-after' appraoach. Such approach cream with **Phyto-p53 liposomes** is not intended to replace the present day sunscreens yet.

A more thermal stable version of Phyto-p53 (expressed from marine one-cell-plant hyperthermophilic micro-organisms that are heat-loving and withstands high heat like Methanococcus and T. aquaticus as already being manipulated in high heat **polymerase chain reactions (PCR) technology**) is being developed to include in the future sunscreen formulations - with the **Phyto-p53 liposomes** that are intending to be high heat and adverse environmental factors stable, on site of UV exposure with immediate UV damage repairs.

These thermal stable versions of **Phyto-p53 liposomes** are developed to overcome imperfect sunscreen and human fallibility.

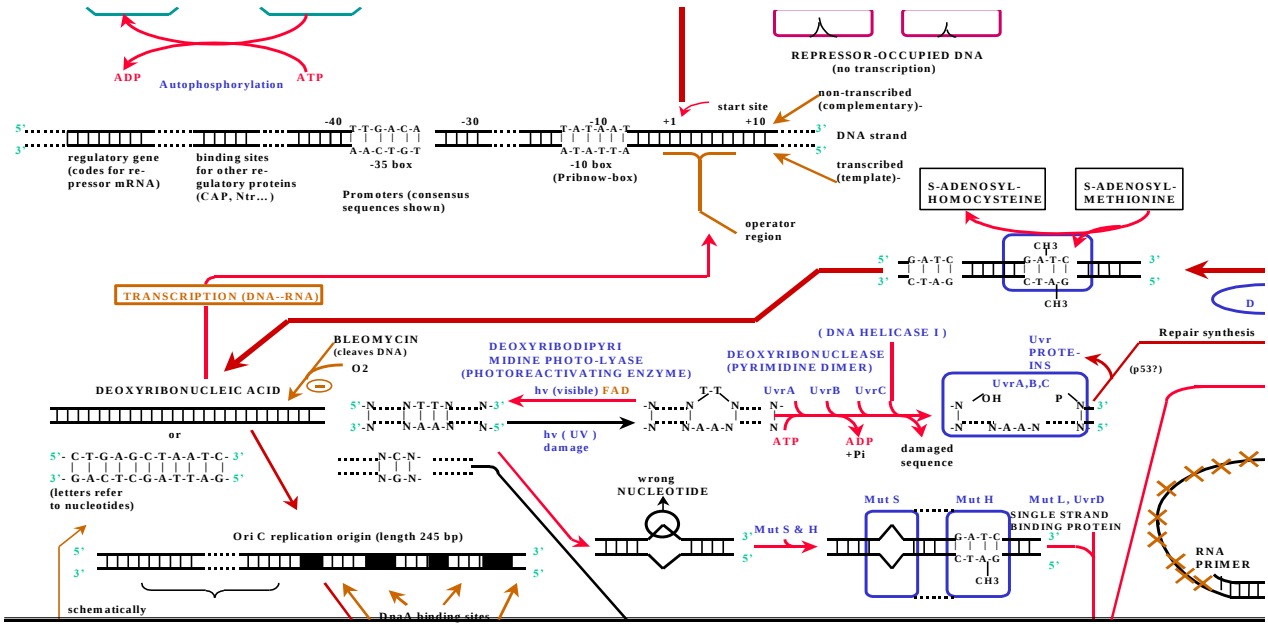


RasMol designed protein p53 that illustrates the structure and function of the tumor suppressor protein, p53. This protein is made up of four separate subunits which pair up and form a tetramer. The protein, p53, has the ability to activate other proteins which can stop the cell cycle until the damage to the cell can be repaired. It also may allow cells to halt growth in response to additional stimuli such as reduced nutritional resources or high cell density. " The p53 gene is one of the most frequently altered genes in human cancer (50% of all cancers have altered forms of p53), so if scientists can devise strategies to reverse the end results of the alterations, there is great promise in widespread therapy. Some current techniques include ionizing radiation and some chemotherapeutic agents (i.e. 5-fluorouracil, etoposide and adriamycin) which induce in cancers with intact p53 genes the expression of the p53 protein. Loss of fully functional p53

benefits tumor cells immediately by releasing them from their normal growth restraints and preventing their self destruction under adverse circumstances." (Scientific American, pp. 24-5)
A 393-amino-acid protein designated **p53** – "p" for protein and "53" for its molecular weight – has been named Molecule of the Year by the editors of the journal Science. This protein plays a major role in the transcription ("reading") of DNA, in cell growth and proliferation, and in a number of metabolic processes. Because p53 suppresses abnormal cell proliferation, it may represent an important mechanism for protection against cancer. It also appears to be involved in programmed cell death, or apoptosis. When a mutation in the p53 gene results in the substitution of one amino acid for another, p53 loses its ability to block abnormal cell growth. Indeed, some mutations produce a p53 molecule that actually stimulates cell division and promotes cancer. Almost 50% of human cancers contain a p53 mutation – including cancers of the breast, cervix, colon, lung, liver, prostate, bladder, and **skin** – and these cancers are more aggressive, more apt to **metastasize,** and more often fatal.

A number of tumor-promoting viruses and environmental carcinogens act via p53. Carcinogenic **aflatoxins** produced by fungi that contaminate foods such as corn and peanuts are known to alter one specific amino acid in p53, while carcinogens in cigarette smoke also cause a characteristic alteration. Strains of human papilloma virus (HPV) linked with cervical cancer – in particular HPV 16 and 18 – produce proteins that promote the destruction of p53. Two other DNA tumors viruses – simian virus 40 and adenovirus – also produce proteins that target p53, eliminate its activity as a transcription factor, and initiate cell transformation.

Since p53 is part of a fundamental pathway in human cell growth, researchers are looking for ways to use it for the diagnosis, prevention, and cure of cancers associated with p53 mutations. (Culotta E, Koshland DE., Science 1993; 262: 1958-1959. Wong M, Gruber J. J Natl Cancer Inst. 1994; 86: 177-182.)



p53 MEDIATED UV DAMAGED DNA REPAIR

Proc. Natl. Acad. Sci. USA
Vol. 94, pp. 11-14, January 1997

Commentary

Sunlight and skin cancer: Another link revealed

Kenneth H. Kraemer*
Laboratory of Molecular Carcinogenesis, National Cancer Institute, Building 37, Room 3E24, Bethesda, MD 20892

ARTICLE
REFERENCES

ARTICLE

Here comes the sun, Here comes the sun, and I say, "It's alright." George Harrison

Skin cancer is the most common neoplasm in Caucasians in the United States with a lifetime risk nearly equal to that of all other cancers combined (1). More than 800,000 people are expected to develop nonmelanoma skin cancer [basal cell carcinoma (BCC) or squamous cell carcinoma (SCC)] this year in the United States (2). Sun exposure is the major environmental agent implicated in induction of nonmelanoma skin cancer (3). While sun exposure begins early in life, the average patient with nonmelanoma skin cancer is about 60 years old (1) (Fig. 1). The article by Jonason *et al.* (4) in a previous issue of the *Proceedings* provides a new insight into the link between sun exposure and nonmelanoma skin cancer and furnishes information about events occurring between the time of initial sun exposure and subsequent skin cancer years later.

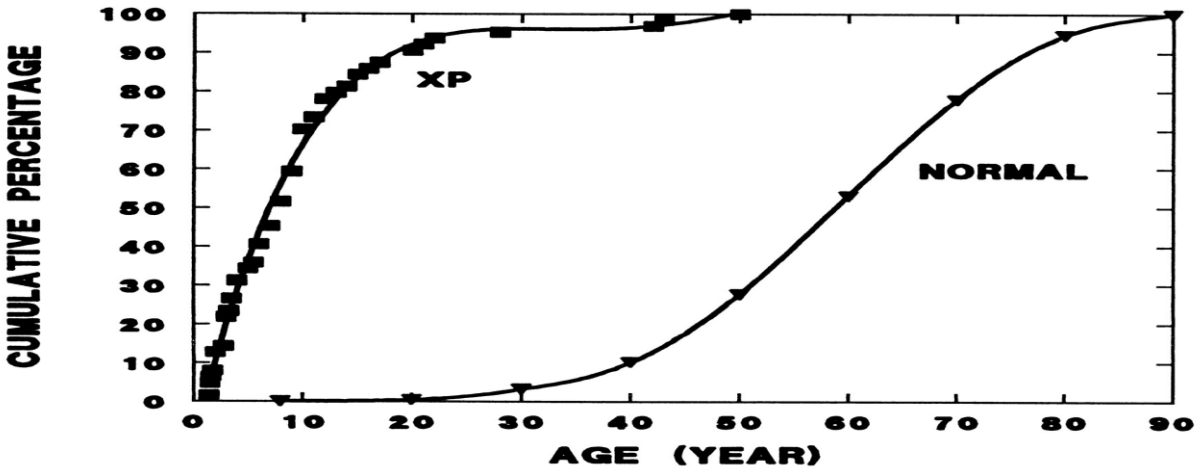


Figure 1

Fig. 1. Age of onset of skin cancers in normal and xeroderma pigmentosum (XP) skin cancer patients. The cumulative percentage of patients with BCCs or SCCs of the skin is plotted versus the age at diagnosis. The curve for the normal population is based on 29,757 skin cancers surveyed by the National Cancer Institute (1). The curve for the xeroderma pigmentosum patients is based on 63 skin cancers reported to the Xeroderma Pigmentosum Registry (unpublished data).

The multistage theory of carcinogenesis is based on experimental studies in rodents and has been proposed as a general model for environmental carcinogenesis (5) (Fig. 2). In the first stage nitiation a carcinogen mutates a target gene. Initiation is followed by promotion, a process in visibly normal skin in which the single damaged cell expands to form a clone of damaged cells. These changes progress, leading to precancerous clinically abnormal skin and then to cancer. Many experimental studies have been designed to dissect the cellular and molecular mechanisms involved in this process. These studies involve investigations of DNA repair, eicosanoid and proteinase production, cytokine activation and immune suppression, and specific tumor-suppressor genes including patched and p53 (Fig. 2).

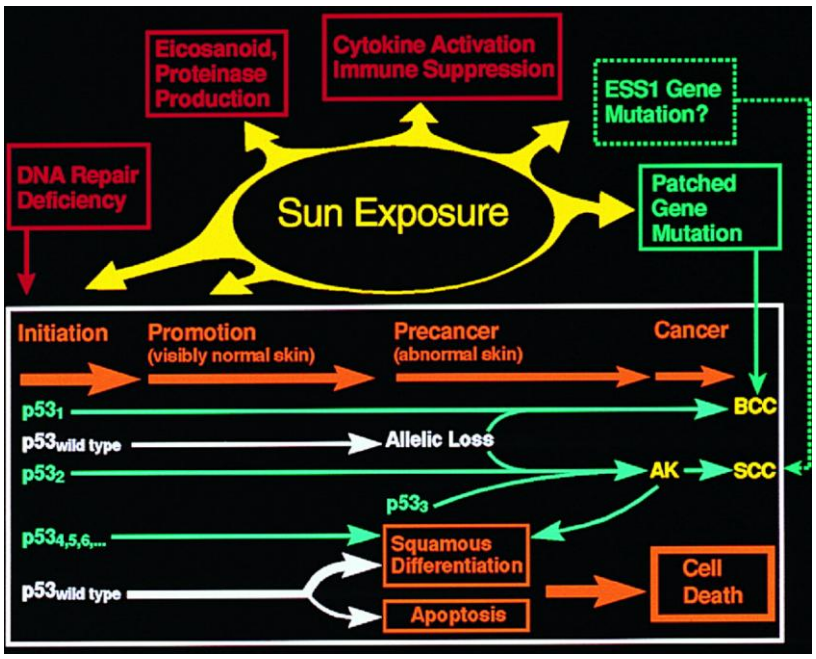


Figure 2

Fig. 2. Effect of sun exposure on the tumor suppressor gene, p53, and on other cellular processes involved in induction of nonmelanoma skin cancer. Sun exposure causes mutations of the tumor suppressor gene, p53 ($p53_1$, $p53_2$, $p53_3$, $p53_4$,), which results in initiated cells, some of which are resistant to apoptosis. Additional sun exposure acts as a promotor permitting these apoptotic-resistant cells to continue to proliferate following UV exposures that inhibit neighboring cells. In a small fraction of cells allelic loss or acquisition of a second p53 mutation on the other allele is associated with a precancerous state, such as an actinic keratosis (AK). A small fraction of these cells eventually become cancerous. This entire process is modified by additional cellular processes such as DNA repair and by processes that are altered by sun exposure including eicosanoid and proteinase production, cytokine activation and immune suppression, and sunlight-induced mutations of other tumor suppressor genes including patched (PTCH) for BCCs and possibly the ESS1 gene [for the multiple self-healing squamous cell epithelioma disorder described by Ferguson-Smith (52, 53)] for SCCs. Additional details are provided in the text.

DNA Repair

Patients with the rare inherited disorder, xeroderma pigmentosum (XP), are very sensitive to sun exposure and have a risk of developing skin cancer about 1000 times that of the general population (6, 7). The age of onset of nonmelanoma skin cancer is reduced by about 50 years in XP patients in comparison to that of the general population (Fig. 1). Cells from XP patients are hypersensitive to killing by UV and to induction of mutations in their DNA by UV exposure (8). These abnormalities are caused by a defect in DNA nucleotide excision repair (9). Work by laboratories throughout the world in the past few years has resulted in cloning of seven different DNA repair genes (XP-A to XP-G) involved in XP (10-12). Mice in which the murine homologue of human XP-A and XP-C genes have been inactivated were shown to have a markedly increased susceptibility to UV induction of skin cancer (13-15). These studies of XP strongly implicate DNA repair in protection against sunlight-induced skin cancer. Recent reports suggest that DNA repair may also be defective in apparently normal individuals with early onset of basal cell carcinoma (16) and in normal people as they age (17).

Eicosanoid and Proteinase Production

Eicosanoids such as arachidonic acid and its metabolites including prostaglandins and leucotrienes are major mediators of the inflammatory response generated by UV exposure (18). These are also produced in response to skin application of chemical tumor promoters such as the phorbol ester phorbol 12-myristate 13-acetate (PMA), which binds to protein kinase C. Inhibitor studies suggest that eicosanoids are essential components of the skin tumor promotion process.

Small doses of UVB to human volunteers were shown to activate cutaneous proteinases (19). This appears to be activated through the AP1 transcription factor and inhibited with retinoids. These proteinases may contribute to tumor cell spreading.

Cytokine Activation and Immune Suppression

People with kidney transplants who are receiving immunosuppressive medications have a very high frequency of developing squamous cell carcinomas on sun exposed skin (20). Studies of the effect of UV on mice with highly antigenic transplanted tumors have indicated that sunlight interferes with host immunity against these cancers (21, 22). UV treatment of the mouse skin resulted in systemic immunosuppression that could be transferred to untreated mice by transfusion of T-lymphocytes (suppressor T cells) and also in keratinocyte production of soluble cytokines such as interleukin 10. In addition to this tumor-specific systemic effect, UV treatment produces a nonspecific local impairment of resistance to tumor growth. These complex mechanisms are mediated through several different factors including alteration of antigen-presenting activity of Langerhans cells, local production of immunomodulatory cytokines such as tumor necrosis factor □, UV isomerization of urocanic acid in the skin and infiltration of the skin by new antigen presenting macrophages.

Studies utilizing liposome encapsulated DNA repair enzymes indicate that DNA photoproducts are involved in induction of immunosuppression (21). Recently, mice that have the XP-A DNA repair gene knocked out were found to have defective post-UV immunity with marked sensitivity to UV-induced depletion of Langerhans cells and greatly enhanced UVB induction of local and systemic immunosuppression (23).

p53 Tumor Suppressor Gene

The p53 tumor suppressor gene is involved in many cellular functions including cell cycle inhibition, regulation of differentiation, transcription, DNA repair, and apoptosis of cells sustaining DNA damage (24). The retinoblastoma gene in familial retinoblastoma is the paradigm of the tumor suppressor gene (25). Affected patients inherit one defective allele and the second allele is subsequently lost or inactivated resulting in a tumor. Patients with the Li-Fraumeni syndrome inherit a mutated form of the p53 gene (26). They have a high frequency of many cancers at an early age. These cancers include rhabdomyosarcoma, soft tissue sarcomas, breast cancer, brain tumors, osteosarcoma, leukemia, adrenocortical carcinoma, lung adenocarcinoma, and melanoma of the skin. These tumors have additional p53 gene mutations.

p53 and Molecular Fingerprints

Mutations in the p53 gene have also been found in about half of all sporadic human cancer cases examined in the general population (27). These p53 mutations have been used in studies of molecular epidemiology because many mutations can inactivate its function and some carcinogens, like UV, leave characteristic fingerprints (24).

UV radiation causes damage to DNA primarily at sites of adjacent pyrimidines (9). The most frequent photoproducts are cyclobutane dimers that are formed at adjacent thymidines (TT), with thymine-cytosine (TC) and cytosine-cytosine (CC) dimers occurring less frequently. Collectively, cyclobutane dimers represent about three-quarters of the photoproducts. The remaining nondimer photoproducts consist mostly of 6-4 pyrimidine-pyrimidone lesions at TC, CC, or TT bases on the same DNA strand. All these photoproducts are removed in normal cells by DNA excision repair (see above) (8-12).

Unrepaired photoproducts may result in a block to replication resulting in cell death. Alternatively, bypass of unrepaired lesions during replication may result in incorporation of the incorrect base opposite the photoproduct resulting in a mutation. When a shuttle vector plasmid was treated with UV *in vitro* and then passed through human cells, the major mutation introduced into the replicated plasmid by the human cells was the G:C to A:T transition (28). This C to T transition was seen in 75% of the mutant plasmids recovered from repair proficient cells and in 96% recovered from repair deficient XP cells (28). All of the five other types of base substitution mutations were also seen, but at a much lower frequency. Most of the C to T mutations occurred at 5□TC sites. In addition to single base substitutions, tandem 5□CC to TT mutations were found. These UV-induced mutations are sufficiently different from those induced by other carcinogens as to form a characteristic fingerprint pattern and have been used to determine the etiologic agent in cases of environmentally induced cancers.

The p53 tumor suppressor gene has been found to be mutated in more than 90% of human cutaneous SCCs and about 50% of human BCCs. Combined analysis of skin cancer mutations from several laboratories (29-35) showed that 69% of the mutations were G:C to A:T with normal patients, and that 90% of the mutations were G:C to A:T with XP patients (35-37). The types of mutations and differences between cancers from repair-proficient and repair-deficient patients were similar to those seen with the UV-treated shuttle vector plasmids strongly supporting the UV origin of these mutations in p53.

p53 Mutations in Skin

While these changes in p53 are seen in frank malignancies, when do they first occur? Do they actually contribute to the neoplastic process or are they merely markers of sun exposure (Fig. 2)? Epidemiologic evidence points to a close linkage between cutaneous SCC and sun exposure. The actinic keratosis (AK) is a premalignant lesion that infrequently (on the order of 1:1000) progresses to SCC (38). AK have a high frequency of loss of portions of several chromosomes resulting in loss of alleles of many genes including p53 (39). Studies of AK have revealed a high frequency of p53 mutations of the type seen following UV exposure (40, 41).

The location of mutations in the p53 gene is not random. Hotspots of C to T and CC to TT mutations are found in skin cancers at certain codons that are different from those seen in internal tumors such as liver cancers induced by aflatoxin or lung tumors induced by cigarette smoking (22). The paper by Jonason *et al.* (4) examined normal appearing skin in patients who did not have skin cancer. They found that sun exposed skin contains clones of cells with characteristic UV-type p53 mutations and a few of these are also in the same sites as seen in AK and SCC.

The protein product of the p53 gene is normally unstable and does not persist within cells. Antibodies to p53 stain cells that contain stable p53 protein. Sequencing of the p53 gene from such cells often, but not always, shows mutations. Nonmelanoma skin cancers and precancers in humans and mice often stain positive for p53. Berg *et al.* (42) demonstrated that 30 daily doses of UVB to hairless mice (which would produce skin tumors at 30 weeks) result in clusters of p53 positive cells in exposed skin. These clusters were observed in 93% of biopsies 1 week after discontinuation of UVB and in 47% of biopsies at 2 weeks. Staining with an antibody for a mutant p53 was positive in 64% and 37% of the biopsies, respectively, indicating an early onset of mutation in histologically normal appearing mouse skin. The paper by Jonason*et al.* (4) examined p53 staining in sun exposed and sun shielded skin from cancer-free normal human donors. They separated the epidermis from the dermis and stained the resulting horizontal sheets of epidermis. Remarkably, they found numerous compact areas of staining in sun exposed normal skin. The frequency and size of staining areas was roughly correlated with the extent of sun exposure and involved up to 4% of the skin cells in sun-exposed areas.

The cells of the human epidermis are constantly turning over (43). Cells in the basal layer divide and daughter cells migrate upward and differentiate into squamous cells, producing keratin and other proteins. Continued squamous differentiation results in flattening of the cell with loss of nuclei and, ultimately, sloughing off of the dead squamous cells (Fig. 2). This process takes about 1 month in normal epidermis of 0.1-mm thickness (43). In order for the skin to remain viable, some cells must remain in the basal layer. These putative stem cells divide infrequently but produce other rapidly dividing cells that then differentiate forming an "epidermal proliferative unit" (43). Normal stem cells have not been unequivocally identified in human skin. Jonason *et al.* (4) used a scanning confocal microscope to reconstruct a three-dimensional immunofluorescent cone of p53 mutated keratinocytes from an epidermal whole mount of sun exposed skin. The apex of the cone was found to be at the dermal-epidermal junction pointing toward the location of an initiating stem cell. The p53 mutation thus serves as a marker for the progeny of a single stem cell. This is perhaps the best evidence to date of the existence of a stem cell in human skin.

However, because these cells are mutated, behavior of clones from non mutated stem cells may be different.

p53, Sun Exposure, and Skin Cancer

A picture emerges from these studies of the role of p53 in sunlight-induced skin cancer (Fig. 2). Sun exposure of normal skin results in many p53 mutations that serve as an initiation process that start the cells on a path toward cancer (40, 44). Sequence analysis of 7 mutations by Jonason *et al.* (4) combined with two more by Ren *et al.* (40) indicates that all nine UV type C to T p53 mutations found in normal skin result in a

change an amino acid of the p53 protein. Are these mutations only passive indicators of sun exposure or do they offer a selective growth advantage? Passive dosimeters should involve all possible positions in a codon with some C to T mutations resulting in silent mutations that do not change an amino acid. Because the knowledge of all inactivating p53 mutations is incomplete, an approximation of what would be expected can be based on the genetic code: of the 48 possible C to T mutations in all triplet codons, 18 will not result in change of an amino acid. Thus finding no silent mutations out of nine sequenced is highly unlikely to be due to chance alone ($P < 0.02$). This is evidence that these p53 mutations do indeed offer some selective growth advantage to the initiated cells.

Sun exposure also serves as a tumor promoter. Normally functioning p53 serves as a type of monitor. Cell damage results in increased stabilization of p53 protein that slows down the cell cycle to permit repair of DNA damage and turns cells sustaining unrepaired DNA damage toward apoptosis (programmed cell death) rather than to normal squamous differentiation (Fig. 2). This is a protective mechanism that rids the skin of severely damaged cells. Cells with defective DNA repair of transcribed genes, such as those from patients with xeroderma pigmentosum complementation group A or Cockayne syndrome induce nuclear accumulation of p53 and apoptosis at much lower UV doses than normal (45, 46).

In skin, cells appearing after UV exposure that have a histologic appearance that has been called "sunburn cells" were demonstrated to be apoptotic cells (47). These sunburn cells are virtually absent in UV-exposed skin of mice with a homozygous knockout of the p53 gene ($p53^{-/-}$), while heterozygous p53 knockout mice ($p53^{+/-}$) have a partially reduced response in comparison to normal ($p53^{+/+}$) mice (47). Thus cells with a single p53 mutation are more susceptible to the tumor promoting effects of sun exposure: they have a diminished p53-mediated apoptotic cell death protective mechanism thereby permitting these cells to continue to survive in an area of skin in which surrounding cells with wild-type p53 are killed by apoptosis. Quantitatively, however, because up to 4% of the normal appearing sun-exposed skin cells have p53 mutations and very few develop into actinic keratoses or cancer, most must eventually undergo squamous differentiation or apoptosis and cell death (Fig. 2).

Eventually, repeated UV insults to cells containing a single p53 gene mutation may lead to a second mutation in the other allele or to loss of a portion of the normal chromosome. This allelic loss is commonly seen in actinic keratoses and is correlated with the appearance of clinically and histologically abnormal skin (39). However, only about 1 in 1000 actinic keratoses develop into squamous cell carcinomas (38). Other factors such as mutations in tumor-specific genes may determine the outcome.

Patched Gene

Patients with the dominant disorder, basal cell nevus syndrome (BCNS), develop multiple cutaneous BCCs, but not SCCs, especially on sun exposed skin (48). In addition, they have a high frequency of developmental abnormalities including jaw cysts, cleft palate, abnormal vertebrae and ribs, and an elevated risk of developing benign and malignant internal tumors such as ovarian fibromas and carcinomas, medulloblastoma of the brain, and cardiac fibromas (48). Therapeutic x-radiation of the skin of BCNS patients results in the appearance of numerous cutaneous BCC. PTCH, the human homologue of the *Drosophila* patched gene on chromosome 9 q22.3, was recently found to be defective in patients with BCNS (49, 50). This gene encodes a transmembrane protein that represses transcription in specific genes encoding members of the transforming growth factor family and is involved in *Drosophila* development.

The PTCH gene was also reported to contain mutations in about one-third of sporadic basal cell carcinomas (51). The types of mutations found, predominately C to T, are characteristic of UV mutagenesis. Thus the PTCH gene may play an essential role in sunlight induction of BCC.

A SCC Gene?

A patient with multiple self-healing squamous epithelioma (multiple keratoacanthomas) with the histologic appearance of squamous cell carcinoma was described by Ferguson-Smith (52, 53). Studies of 13 affected families with this squamous cell-specific disorder indicated dominant inheritance and located a gene (called ESS1) at 9q31 by linkage analysis (54). The pattern of allelic loss on chromosome 9 is different in SCC from that in BCC (55, 56). The ESS1 gene has not yet been identified, but by analogy to the patched gene in BCNS and BCCs, the ESS1 gene may play a role in squamous cell carcinomas.

Conclusion

The Jonason *et al.* (4) paper shows that p53 mutations occur very early in the process of skin carcinogenesis and are seen in many relatively large areas of normal appearing, sun exposed skin. Most of these initiated cells containing p53 mutations eventually are lost through normal differentiation or cell death. However, these mutations appear to confer a survival advantage following repeated sun exposure (promotion) leading to abnormal appearing precancerous cells with a second p53 mutation or with loss of a portion of the normal chromosome. Most of these cells eventually die, but some go on to form skin cancer. It appears that this is only a part of the story. Patients with germ line p53 mutations (the Li-Fraumeni syndrome) do not have a high frequency of nonmelanoma skin cancers (or indeed, of colon or liver cancers that also usually have p53 mutations). Additional factors are probably essential for UV carcinogenesis such as diminished DNA repair, or sunlight-induced production of eicosanoids, proteinases, and cytokines resulting in immune suppression as well as mutations of tumor-specific genes.

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CAMPO RESEARCH
PRODUCT TECHNICAL DATA INFORMATION

INGREDIENT NAME: **CAMPO THULASI ASHVINI ROOT OIL**
PRODUCT NUMBER: 95/ 02 / 10

Product description

Thulasi Ashvini root (Radix Ocimum sanctum) in vacuum distilled oil is a pure herb oil with remarkable UV-extinction; exhibiting a specific co-efficient of extinction of 36.0 (cm2/mg), which translate into as follows: addition of 10% Thulasi Ashvini root oil (in a formulation) can absorb 90% UV-B light.

Thulasi Ashvini root oil has various *enzymatic principles* **(UVzymes™)** intact, which are meticulously extracted via proprietary extraction technique(s) utilizing gaseous Carbon dioxide (in-vacuum at low temperature – minus 3°C) and critical ultra temperature steam distillation (in-vacuum), and the resultant multi-component extracts of both techniques are re-constituted as an active functional oily cosmetic ingredient for topical use.

SPECIFICATION

SPECIFIC GRAVITY (20℃)	0.800 - 0.995	USP XXIX / Paar, DMA 46
REFRACTIVE INDEX (20℃)	1.450 -1.470	USP XXIX / DGF CIV 5/52
TOTAL GERMS	< 100 cfu/ ml (**non-pathogenic**)	In-vacuum magnetized - Huddle Filtration and
TOTAL YEAST / MOLD	< 100 cfu / ml	- Membrane Filtration
COLOR	LIGHT CLEAR YELLOW TO CLOUDY ORANGE	Visible
APPEARANCE	OILY LIQUID	Visible
ODOUR	ODOURLESS TO VERY FAINT CHARACTERISTIC	Aromascan
Application: *As additive in sun-care, sun-protection, skin-care formulations, W/O and O/W emulsions, etc.* *Day creams and foundations, UV protection everyday shampoo and hair lotion.*		
Dosage Level:	5 - 20%	
Comments: The above specification may change without prior notice. Not for re-sale / re-export or pharmaceutical / drug use without prior permission		
Remark: Another Ocimum sanctum product with UV-A & B extinction is available as colorless clear odoriferous oil (available on request)		

FOR MATERIAL SAFETY & ANALYTICAL LABS.

CAMPO RESEARCH

CAMPO RESEARCH
PRODUCT TECHNICAL DATA INFORMATION

INGREDIENT NAME: **CAMPO MUTHU THULASI T4 ENDONUCLEASE EXTRACT**
PRODUCT NUMBER: 95-10-12 T4N5 PLANT

Product description

A complex solution of **T4 ENDONUCLEASE V ENZYME AND OTHER SIMILAR T4 ENDONUCLEASE V ENZYMES** isolates from Thulasi Ashvini root cells and purified water USP; that speed up and augment the body's repair of skin DNA and excise (removal as dry peeling skin fragments) dead cell or cause apoptosis (normal programmed cell death to excise and remove old and environmental factors cause damaged cells (as controlled skin peeling).

The **T4 Endonuclease V Enzymes** are collectively labelled as **Phyto-T4N5 (UVzymes™)** as its source of origin is expressed from the herb Thulasi Ashvini (Ocimum sanctum Linn) root cells – as a common biological host of expression .

CAMPO MUTHU THULASI T4 ENDONUCLEASE V EXTRACT -- *This is a novel new biotechnology substitute for alpha-hydroxy acids, for use as a facial skin rejuvenation peeling agent and a potent UV absorbing and filtering agent.*

SPECIFICATION

Specific Density	1.020 - 1.180	USP XXIX / Paar, DMA 46
Dry Residue	10% - 65% w/v	Mettl L J 16
Phyto-T4N5 content	20 - 25%	Enzymes Method 95
Extraction Solvent	Water Purified USP	
Extraction Gases	Nitrogen, Carbon Dioxide	
Colour	Light reddish brown to cloudy white	
Odour	Faint Characteristic	
Appearance	Liquid	
Solubility	Soluble in water	
pH	1.5 - 5.5	USP XXIX / 4.71 DGFIVC 52
Pesticides	Nil	
Microbiology	GERMS <100 cfu/mg Yeast/Mold <100 cfu/mg	Membrane Filtration
Preservative	Nil	Magnetised in-vacuum - HuddleTech.
Recommended USE and Application LEVEL:		
Facial Peeling, Facial New Skin Rejuvenation, Peeling Mask functional products: 1.5-20% UV absorbing and filtering / sunscreens: 0.5 - 1.0%		
Comments: SHAKE WELL BEFORE USE Gel may form on long term storage but will dissolve with shaking the container.		
Legal Usage : This ingredient will sold or contracted to be sold at the sole discretion of Campo Research.		

MATERIAL SAFETY & CONSUMER SAFETY ANALYTICAL LABS.,

CAMPO R&D

EXPERIMENTAL UV INDEX

THE EXPERIMENTAL ULTRAVIOLET INDEX FACTSHEET: EXPLAINING THE INDEX TO THE PUBLIC

INTRODUCTION

In response to the increasing incidence of skin cancer, cataracts, and other effects from exposure to the sun's harmful rays, the National Weather Service (NWS), the U.S. Environmental Protection Agency (EPA), and the Centers for Disease Control and Prevention (CDC) are collaborating on a new sun awareness information program.

Central to this program is an Experimental Ultraviolet (13V) Index which has been developed by the National Meteorological Center, a part of the National Weather Service. The EPA Office of Research and Development provided partial funding for the development of this Index. The Index is a next-day forecast of the likely exposure to ultraviolet radiation for a particular location at noon. This summer the NWS will issue the Index as a daily product on a experimental pilot basis for a limited number of cities.

"Be Sun Wise!" is a public information program supporting the UV Index. Its goal is to inform individuals about how to use the Index to prevent overexposure to the sun for themselves and others, especially children.

Several publications are being issued at the same time as this UV Experimental Index is being announced.

Information on how to obtain these publications is given in the "For Additional Information" section at the end of this publication.

> A publication, *Draft NOAA -EPA Program to Provide Experimental Operational Forecast Guidance of an Index of UV Radiation at the Ground,* has been written for the NWS field staff and the professional meteorological community.

> A brochure, *Experimental Ultraviolet Index: what You Want to Know ,* is intended to explain the Index to the public. It is available in quantity.

> This publication, *The Experimental Ultraviolet Index Factsheet: Explaining the Index to the Public,* provides information about how these Index values can be explained to the public. The primary audiences for this factsheet are meteorologists, public health officials, physicians, and other professionals who are

likely to be called upon to answer public inquiries about the Index or who can make use of the Index to increase public awareness about the hazards of overexposure to UV rays.

> A supplementary publication, *Technical Appendices to the Experimental UV lndex Factsheet,* provides more in-depth information about the Index and how EPA has calculated the minutes to burn associated with the different exposure levels. The primary audience for that publication is professionals in the meteorological and medical communities who want more technical information about these issues.

> A separate publication, *Bulletin of Sample Public Health Messages to Accompany the UV lndex,* provides a variety of public health action messages that can be used when the Index values are presented to the public.

WHAT THE INDEX IS

Starting in the summer of 1994, the National Weather Service (NWS) and EPA are offering a new product, the UV Experimental Index. It is being issued daily on an experimental basis for use by meteorologists as part of their weather report. The Index is a next day forecast of the amount of ultraviolet radiation that will reach the earth's surface during the peak hour of sunlight around noon. The Index includes the effects of cloud cover on the anticipated UV exposure level for the next day.

The Index is a number on a scale of *0-15*. The NWS distributes this Index number for a selected number of cities across the country. It is sent out by the NWS about 1:00 EDT each day to its field operations and the weather forecasting community.

Table 1 below lists five exposure category descriptors (e.g., minimal, low, moderate, high, very high) that can be used to explain the intensity of each of the Index values.

A variety of public health messages for each exposure category is suggested in the EPA publication, *Bulletin of Sample Public Health Messages to Accompany the Experimental UV Index.*

Table 1: Index Values and Exposure Categories

INDEX VALUES	EXPOSURE CATEGORY
0-2	Minimal
3-4	Low
5-6	Moderate
7-9	High
10 +	Very High

THE EXPOSURE CATEGORIES

The exposure categories play a key role in the sun awareness public health messages associated with the Index. EPA set the exposure categories based on sunburning of fair-skinned persons because it provides an easy4o-understand measure of imrnediate effects. This is a conservative approach, which is meant to be protective of people who are less likely to sunburn but who are at risk of the other longer4erm health effects from UV exposure that do not depend on skin type.

Some people with skin types will learn that they need to take more precautions to protect themselves from sunburn that the exposure descriptors would indicate; others will realize that they are not as sensitive and therefore do not have to be so cautious.

What is important is that people of all skin types can use the Index to help them prevent diseases of the skin and eye that result from overexposure to UV rays.

FACTORS AFFECTING INDIVIDUAL EXPOSURE

It is important that the public be educated on the factors that can affect UV radiation so that the public make the best use of the Index. In s6me cases, the factors that influence the noon time UV levels may change over the course of a day or during a year at a given location. These factors may change as an individual travels short or long distances from where the Index is given.

One of the most important factors is cloud cover. Partly or variably cloudy days do little to reduce UV exposure. However, rainy or substantially overcast days will reduce UV exposures in some cases by 50 percent or more. Furthermore, depending on the accuracy of the forecast of cloud cover at noon and the change in cloud cover during the day, the forecast could overstate or understate the actual UV intensity at certain times during the day.

For example, if the forecast for the next day at noon is for overcast skies, but the overcast conditions fail to occur or there are sunny skies at other times of the day, people may take too few precautions and be overexposed. In contra, if clear sky conditions are forecast but the day turns cloudy, the UV Index would overestimate the UV intensity and people may not need the precautions they had planned.

Another important factor in determining the amount of exposure an individual receives is the time of day spent in the sun. The Index is the predicted UV exposure for the hour around noon. The earlier or later one goes out in the sun, the more exposure will be reduced. The peak exposure time is 12:00 p.m. Standard Time (ST) and 1:00 p.m. Daylight Savings Time (DST). In the continental United States, the UV intensity is reduced by about half at three hours before and three hours after the peak exposure time. For example, the UV intensity at 10 a.m. and 4 p.m. is half as strong as it is at 1:00 p.m. DST.

The time of year also affects the amount of UV radiation reaching the earth's surface. The greatest amount of UV is received in the late spring and early summer, much less is received in the late fall and early winter.

UV intensity also varies by latitude and altitude, with higher values occurring as one gets closer to the equator or higher in elevation. Smog conditions can reduce UV intensity.

The role of reflective surfaces is also important in determining the amount of exposure. Water, sand, and snow all reflect UV rays and can intensify exposure.

Lifestyle decisions can override other factors in determining a person's risk from exposure to the sun. People who work or play outdoors for long periods of time are at greater risk of harmful effects from UV exposure. Activities such as skiing, sunbathing, or swimming can lead to extremely high exposures. Use of tanning parlors also increase risk, because UV radiation from any source contributes to long term damage.

UV RAYS AND HOW OVEREXPOSURE TO THEM CAN BE HARMFUL

Energy from the sun reaches the earth as visible, infrared, and ultraviolet rays. Ultraviolet A is made up of wavelengths 320 to 400 nanometers (urn) in length; ultraviolet B wavelengths are 280 to 320 nm; and ultra-violet C wavelengths are 100 to 280 urn. Because the earth's atmosphere absorbs the UVC wavelengths, the only ultraviolet rays that reach the earth's surface are UVA and UVB.

While a small amount of exposure to sunlight can be healthy and pleasurable, too much can be dangerous. Exposure to UV rays is linked to a number of harmful health effects.

Skin cancer and other skin damage. Some effects of sunlight on the skin are visible within hours or days (e.g., sunburn and tanning); other effects are delayed and cumulative and may be seen in months to years (e.g., skin cancer and photoaging).

Skin cancer. The incidence of skin cancer cases is increasing rapidly. Over 1,000,000 new cases of skin cancer are likely to be diagnosed in the U.S. this year. Eighty percent of the UV exposure occurs before the age of 18 and the damage is cumulative over time. UV radiation exposure is implicated in the formation of non-melanoma and melanoma cancers.

Premature aging. Sun exposure also causes premature aging of the skin. Photoaging of the skin is different than normal chronological aging. Regular sun bathers show photoaging changes early in life (before 30 years of age); while chronologically aged skin shows changes later (after 40 or more years of age). Freckling, fine wrinkling, and dilatation of capillaries are often seen early in the photoaging process; later on the photoaged skin develops irregular pigrnentation, often called liver spots. Both photoaging and chronological aging cause wrinkling and loss of skin elasticity; however, they occur much earlier when the skin has been overexposed to the sun.

Cataracts and other eye disorders. Cataracts are a leading cause of blindness worldwide. UV exposure is one of the risk factors *in* the development of cataracts. Corneal sunburn, growths on the outer surface of the eye, and other eye diseases are also known or suspected to be related to long-term exposure to UV radiation.

Immune System Damage. The skin is part of the body's natural defense system. While there is much to be learned, it is clear that ultraviolet radiation can alter immune functions. When UV radiation suppresses immune responses, it reduces the body's ability to fight off certain diseases, including skin cancer. Overexposure to UV radiation may also interfere with the efficacy of immunizations administered through the skin.

UVB rays pose a much greater risk of skin cancer than UVA. However; UVA rays cause aging, wrinkling, loss of elasticity, and augment the damaging effects of UVB, including skin cancer and cataracts. The five exposure categories include exposure to both UVA and UVB.

Common sense measures to prevent overexposure to sunlight can substantially reduce the risks of cancers and aging of the skin, cataracts, and other harmful effects.

HOW PEOPLE SHOULD USE THE UV INDEX

EPA is collaborating with CDC in the initiation of a "Be Sun Wise!" public education campaign to coincide with the release of the Index. This campaign is aimed at raising public awareness of the health risks of sun exposure. The challenge is great because attitudes about the attractiveness of a "healthy tan" are so firmly established.

Preventing skin cancer and other skin damage.

Because individual susceptibility to sunburn varies widely, each individual should determine his or her own skin type. Refer to "Table 2: Description of Skin Phototypes" below.

The first step in classifying an individual1s skin type is to look at the color of skin on parts of the body that have received the least amount of exposure to the sun. Lower legs just above the ankles, behind the knee, or the inner side of the upper arm are possible places to use. People should not use the exposed skin on the face, neck, or arms (or chest for men) because the color in these areas has been altered by past sun exposure.

Other factors including genetic history, age, number of previous severe sunburns, and medical history are also important. Individual determinations about skin type should be made after careful consideration of all these influences. Hasty self-typing can result in actions which lead to overexposure to the sun.

Table 2: Description of Skin Phototypes

SKIN PHOTOTYPES	SKIN COLOR IN UNEXPOSED AREA	TANNING HISTORY
Never Tans/Always Burns	pale or milky white; alabaster	develops red sunburn; painful swelling; skin Peels
Sometimes Tans/ Usually Burns	very light brown; sometimes freckles	usually burns; pinkish or red coloring appears; can gradually develop light brown tan
Usually Tans/ Sometimes Burns	light tan, brown, or olive; distinctly pigmented	rarely burns; shows moderately rapid tanning response
Always Tans/ Rarely Burns	brown, dark brown or black	rarely burns; shows very rapid tanning response

Even within the same skin type, people may burn at different rates. Individuals should decide if they are more or less sensitive to sun exposure and take protective actions accordingly.

The American Academy of Dermatology and the Skin Cancer Foundation recommend the following actions to reduce the chance of both sunburn and skin cancer:

> Minimize sun exposure at midday (10:00 a.m. to 3:00 p.m.)

> Apply a sunscreen with SPF- 15 or higher to all exposed areas of the body.

> Reapply sunscreen every two hours, even on cloudy days. Also, reapply after swimming or perspiring.

> Wear clothing that covers the body and shades the face.

> Avoid unnecessary exposure to radiation through sunlamps or tanning parlors.

> Protect children by keeping them from excessive sun during the hours of strongest sunlight and by applying sunscreen liberally and frequently to children older than 6 months of age. (Because sunscreen should not be used on children under 6 months, their sun exposure should be *severely* limited.)

Preventing cataracts and other eye diseases.

Unlike individual susceptibility to sunburn and cancer, susceptibility to eye damage from UV may well be similar for all types of people.

The National Society to Prevent Blindness, the American Optometric Association, and the American Academy of Ophthalmology recommend the following actions to prevent eye damage from UV radiation:

o Wear sunglasses consistently when outside during the sunlight hours. Wearing regular glasses also affords some measure of protection against UV rays.

o Wear broad-brimmed hats to shade the eyes. (Hats that shade the back of the neck also protect the skin.)

Choose sunglasses carefully. Sunglasses should absorb 99-100 percent of the full UV spectrum. Because there is now no uniform labeling of sunglasses, people should read labels carefully to be sure that the lenses will absorb both UVA and UVB light. They should be wary of claims that sunglasses "block harmful UV light" without saying how much and claims of "protection", instead of "blockage" or "absorption."

WHAT ROLE DOES OZONE LAYER DEPLETION PLAY?

The stratospheric ozone layer shields the earth from the sun's harmful ultraviolet rays. It is well established that decreases in the stratospheric ozone far above us can lead to increases in UV at the surface. Ozone changes from day to day and place to place.

Long-term decreases in the average amount of ozone have been measured over the past decade. A better monitoring network is necessary to demonstrate whether there has been a corresponding change in UV radiation in the United States. Future levels of ozone and UV will depend upon a combination of natural and manmade factors, including CFCs.

Experts agree that increased exposure to harmful rays can contribute to long term increases in skin cancer and cataracts, and harm animals and plants. It is likely that current rising rates of skin cancer are related to the increasing emphasis on outdoor leisure and work in our society. Whatever the source of risk, it is important to protect yourself and your family from overexposure to harmful UV rays.

FOR ADDITIONAL INFORMATION

ORGANIZATIONS

Federal Agencies

The following federal agencies have information on the UV Index or related issues, including skin cancer and ozone depletion. Public inquiry telephone numbers are provided where available.

NOAA/National Weather Service
National Meteorological Center
Washington, DC 20233
01-713-0622
(for information on Experimental UV Index)

Be Sun Wise! Program
U.S. EPA
401 M Street SW (6205J)
Washington DC 20460
(for information on Index and health messages)

EPA Stratospheric Ozone
Information Hotline
1-800-296-1996

Centers for Disease Control and Prevention
National Center for Chronic Disease Prevention and Health Promotion
Division of Cancer Prevention and Control 4770 Buford Highway NE,
Mailstop K-57
Atlanta, GA 30341-3724
(for information on public education about skin cancer)

Cancer Information Service
National Cancer Institute
1-800-4-CANCER
(for information on skin cancer)

Private Sector

American Academy of Dermatology
930 North Meacham Road
P.O. Box 681069
Schaumburg, IL 60168-4014

American Academy of Ophthalmology
Public Inquiries Unit
P.O. Box 7424
San Francisco, CA 94120-7424

American Cancer Society
l-800-ACS-2345

American Optometric Association
243 N. Lindbergh Blvd
St. Louis, MO 63141

Skin Cancer Foundation
245 Fifth Avenue
New York, NY 10016
212-725-5176

Prevent Blindness America
500 East Remington Road
Schaumberg, IL 60173-5611
1-800-331-2020

In addition, you may also find helpful information by calling or writing health care providers in your own community, including local medical societies. Also talk with your own personal physician.

PUBLICATIONS

Brochures

The following brochures or flyers provide information on the Index and related issues. See above for addresses (and public inquiry telephone numbers where available).

American Academy of Dermatology. *Melanoma/Skin Cancer.* 1993.

American Association of Ophthalmology. *Sunglasses.* 1993.

American Association of Ophthalmology. *The Ocular Hazards of UV Exposure.* 1993.

EPA, NWS, CDC (in collaboration with many other organizations). *Experimental Ultraviolet Index: what You Want to Know.* 1994.

EPA. *Technical Appendices to the Experimental UV Index Factsheet.* 1994.

EPA. *Bulletin of Sample Health Messages to Accompany the Experimental UV Index.* 1994.

EPA. *Experimental UV Index Qs & As for Meteorologists.* **1994.**

EPA *Protecting the Ozone Layer: A Ciuzents Checklist.* **1994.**

National Cancer Institute/NIH. *what You Need to Know About Skin Cancer.* **1992.**

NWS. *Draft NOAA-EPA Program to Provide Experimental Operational Forecast Guidance of an Index of UV Radiation at the Ground.* 1994.

Prevent Blindness America. *UV A Hazard to Sight.* 1994.

Other Books and References

Robins, Perry. *Sun Sense: A Complete Guide to Prevention, Early Detection, Treatment of Skin Cancer.* The

Skin Cancer Foundation. 1990.
Tilton, Buck and Roger Cox. *Ozone, UV and Your Health: 5O Ways to Save Your Skin.*
ICS Books, Inc. Merrillville, Indiana. 1994.

EXPERIMENTAL UV INDEX

TECHNICAL APPENDICES TO THE EXPERIMENTAL UV INDEX FACTSHEET

Starting in the summer of 1994, the National Weather Service (NWS) and the U.S. Environmental Protection Agency (EPA) are offering a new product, the Experimental UV Index. It is being issued daily on an experimental basis for use by meteorologists as part of their weather report. The Index is a next day forecast of the amount of ultraviolet radiation that will reach the earth's surface during the peak hour of sunlight around noon. The Index includes the effects of cloud cover on the anticipated UV intensity for the next day.

The U.S. Environmental Protection Agency (EPA), collaborating with the Centers for Disease Control and Prevention (CDC), has initiated a public information campaign to coincide with the release of the Index. This campaign is aimed at raising public awareness of the health risks of sun exposure. The challenge is great because attitudes about the attractiveness of a "healthy tan" are so firmly established.

This publication, *Technical Appendices to the Experimental UV Index Fact sheet,* is intended to act as a supplement to another publication, *The Experimental UV Index Fact sheet explaining the Index to the Public*. The primary audiences for the fact sheet are meteorologists, public health officials, physicians, and other professionals who are likely to be called upon to answer public inquiries about the Index on who can make use of the Index to increase public awareness about the hazards of overexposure to UV rays.

These appendices provide more in-depth information about two methodologies: the calculations for the Index and the calculations for the minutes to sunburn for the skin photo types described in the fact sheet.

It is anticipated that professionals in the meteorological community will be interested in Appendix A (the explanation of the UV Index). Professionals in the medical community will be more interested in Appendix B (the explanation of MEDs) and Appendix C (the explanation of the minutes to burn) provided by EPA. Although every effort has been made to provide a basic explanation of each set of calculations, it may be that members of either group will find that the explanation of the material outside their area of expertise is not wholly clear. A number of sources of information are given at the end of this document and more are cited in the UV fact sheet cited above.

APPENDIX A: HOW THE INDEX IS CALCULATED

The forecast methodology relies on the relationship between solar angle, total column ozone, cloud coyer, elevation, and UV radiation.

First, projected next-day ozone values are calculated. To do this, measurements of total column ozone for yesterday taken by NOAA satellites are used as inputs. This data is modified based on projected changes in various meteorological fields (i.e., circulation and temperature at specified altitudes) for tomorrow. The resulting forecast is for tomorrow's ozone values.

Second, calculations of the peak amount of ultraviolet radiation reaching the earth's surface under clear sky conditions are made. Using these projected ozone values as an input; a radioactive transfer model calculates the amount of ultraviolet radiation that could reach the earth's surface at solar noon. (Local solar noon is at 12:00 Standard Time or 1:00 Daylight Savings Time.) This information yields the maximum amount of exposure possible at a location.

Third, a weighting function is applied to match the performance characteristics of the surface-based observing systems. This value is used in later calculations as a dose rate.

Fourth, the results are then integrated over the solar noon hour to provide a maximum solar noon clear sky exposure. (Solar noon hour extends from one half hour before solar noon to one half hour after solar

noon.) The results from this calculation, which are expressed in hectoJoules per square meter ('1ectoj/m2), typically fall into a range between 0-1 5.
Fifth, the noon time dosage is then further modified by a factor to account for the presence of clouds in the forecast. This factor, which ranges from 1.0 to 0.31, is determined by an equation which uses the forecasted probabilities of clear skies, scattered clouds, and broken clouds as inputs. The equation is derived from statistical comparisons of the forecasted probabilities and the ratio of the observed and computed clear sky UV levels for multiple sites at different geographic/climatic locations within the United States. The final number is then disseminated as the forecasted Experimental UV Index.

To make this Index a useful public information tool, the Environmental Protection Agency has developed exposure level categories (e.g., minimal, low moderate, high, and very high). In addition, EPA has issued a publication with illustrative public health messages for each of the five categories. (See publication, *Bulletin of Sample Public Heath Messages to Accompany Experimental UV Index.)* In particular, these messages are being made available for use by broadcast meteorologists, if they so choose. It is hoped that wide distribution of these messages will help the public better interpret the Index and will encourage people to take preventive steps to reduce the risks of overexposure.

APPENDIX B: EXPLANATION OF MINIMAL ERYTHEMAL DOSES (MEDs)

A MED is defined as "the smallest amount of sunlight exposure necessary to induce a barely perceptible redness of the skin within 24 hours after sun exposure." [Perry Robins, *Sun Sense.]* It is a widely used measure of skin damage from the sun. MEDs are a useful tool in predicting an individual's response to the energy dosage represented by each of the Index values.

Medical researchers study MEDs under controlled conditions in laboratories or other research facilities. The amount of energy it takes to produce a MED varies for many reasons, including the laboratory equipment, the experimental conditions, varying degrees of pigmentation among subjects, and differences in thickness of skin and amount of previous UV exposure on parts of a single individual's body. As a result, definitions of MEDs can vary among researchers or health practitioners.

As this discussion would indicate, the dosages of solar energy needed to produce reddening or erythema (the MED) can vary for a single person. Even greater variability in MEDs is seen among people with different skin phototypes.

To make use of the MEDs in public information efforts, it is necessary to use some set of skin types. For purposes of the educational efforts associated with the UV Index, EPA is using a set of four skin phototype categories and a set of minimal erythemal doses associated with each. Since there are gradual variations of coloration in human beings, the ranges of energy required to produce minimal redness overlap. Information on the skin phototypes and MEDs used by EPA is given in the figures below.

EPA recognizes that there are other characterizations of skin types with fewer and greater numbers of skin type categories. There are also different calculations about the energy doses needed to produce one MED for the various skin types.

Figure 1: Description of Skin Photo types

SKIN PHOTOTYPES	SKIN COLOR IN UNEXPOSED AREA	TANNING HISTORY
Never Tans/ Always Burns	pale or milky white; alabaster	develops red sunburn; painful swelling; skin peels
Sometimes Tans/ Usually Burns	very light brown; sometimes freckles	usually burns; pinkish or red coloring appears; can gradually develop light brown tan
Usually Tans/ Sometimes Burns	light tan, brown, or olive; distinctly pigmented	rarely burns; shows moderately rapid tanning response
Always Tans/ Rarely Burns	brown, dark brown, or black	rarely burns; shows very rapid tanning response

Figure 2: Skin Photo types and MEDs

SKIN PHOTOTYPES	**ENERGY (MINIMAL ERYTHEMALDOSE REQUIRED TO PRODUCE REDDENING**		
Never Tans/ Always Burns	10	- 30	mJ/cm2
Sometimes Tans/ Usually Burns	30	- 50	mJ/cm2
Usually Tans/ Sometimes Burns	40	- 75	mJ/cm2
Always Tans/ Rarely Burns	50	- 120	mJ/cm2

Figure 3: Skin Photo types and Erythemal Doses Graphed

(Not provided on internet because it is a graphic product; original fact sheet which can be ordered from 1-800-296-1996 has the graph)

APPENDIX C: HOW THE MINUTES TO SUNBURN ARE CALCULATED

People are likely to ask how to use the Index number to make decisions about limiting their exposure to the sun. To help provide guidance about how to answer this question, "Figure 3: Range of Minutes to Burn for Different Index Values" includes minutes to sunburn for the most and least susceptible skin types. The explanation of how these numbers have been calculated follows.

First, the Index value is converted to milliJoules per square centimeter. (The Index is the amount of UV energy in hectoJoules per square meter, which is then rounded off to the nearest whole number.)

Second, the number of MEDs in the solar noon hour is calculated. As explained in Appendix B above, a MED is the minimal ultraviolet radiation energy required to produce just perceptible reddening of previously unexposed skin twenty-four hours after exposure. MEDs vary for different skin photo types. See "Figure 2: Skin Photo types and MEDs" for the energy units for minimal reddening used in these calculations. To calculate the number of MEDs at solar noon, the number of milliJoules per square centimeter computed in step one above is divided by the energy required to produce one MED.

Third, the time required for sunburn is calculated by dividing 60 minutes (number of minutes in the solar noon hour) by the number of MEDs. In this way, a range of minutes to burn for each skin type and each number on the UV Index scale can be produced.

Figure 4: Two calculations of minutes to burn for a sample day under different sky conditions.

Minutes to burn for sample day described above with prediction for clouds (UV Index of 5):

UV Index (UV energy expressed in hectJoules/m2 and rounded off to nearest whole number:	5
Convert *to* millijoules/cm2: (multiply by 10)	50 mjoules/cm2
Energy for minimal erythema for Never Tans skin type (taken from attached figure):	10 mjoules/cm2
Number of MEDs in one hour: (50 mJ/cm2 divided by 10 mJ/cm2)	5 MEDs
Minutes to sunburn for Never Tans skin type at DV Index of 5:(divide 60 minutes by 5 MEDs)	12 minutes

Minutes to burn for sample day if prediction had been for no clouds (UV Index of 9):

UV radiation dosage (UV Index which has been rounded off from hectojoules/m2):	9
Convert to millijoules/cm2: (multiply by 10)	90 mjoules/cm2
Energy for minimal erythema for Never Tans skin type:	10 mJoules/cm2
Number of MEDS in one hour: (90 Mj/cm2 divided by 10 mJ/cm2)	9 MEDs
Minutes to sunburn for Never Tans skin type at UV Index of 9: (divide 60 minutes by 9 MEDs)	6 minutes

There is a large difference between ranges of minutes to bum under the sky with no clouds scenario and the sky with clouds scenario. These calculations demonstrate the fact that an important part of the public information effort accompanying the release of the UV Index must be to educate people on the fact that the relationship between the UV Index forecast (which includes cloud cover) and the potential for much greater UV exposure if cloud cover is not present.

EXPOSURE CATEGORIES / INDEX VALUES		**MINUTES TO BURN FOR "NEVER TANS" SKIN PHOTOTYPE (most susceptible)**	**MINUTES TO BURN FOR "RARELY BURNS" SKIN PHOTOTYPE (least susceptible)**
Minimal	0- 2	30 minutes	120 minutes
Low	3	20minutes	90 minutes
	4	15minutes	75 minutes
Moderate	5	12 minutes	60 minutes
	6	10 minutes	50 minutes
High	7	8.5 minutes	40 minutes
	8	7.5 minutes	35 minutes
	9	7 minutes	33 minutes
Very High	10	6 minutes	30 minutes
	11	5.5 minutes	27 minutes
	12	5 minutes	25 minutes
	13		

Also refer *to* Figure 6: Range of Minutes to Burn Range between Most and Least Susceptible Skin Photo types." It is a more visual presentation of the range *of* time to burn intervals for the most and least susceptible skin types for the range of possible DV exposures presented in Figure 5 above.

Figure 6: Minutes to Burn: Range Between Most Sensitive and Least Sensitive.

(Not provided on internet because it is a graphic product; original fact sheet which can be ordered from 1-800-296-1996 has the graph)

OTHER RESOURCES FOR MORE INFORMATION. The following federal agencies have information on the DV Index or related issues, including skin cancer and ozone depletion. Public inquiry telephone numbers are provided where available.

NOAA/National Weather Service
National Meteorological Center

Washington1 DC 20233
301-713-0622
(For information on Experimental UV Index)

Be Sun Wise! Program
U.S. EPA
401 M Streets SW (6205J)
Washington DC 20460
(For information on Index and health messages)

EPA Stratospheric Ozone Information Hotline
1-800-296-1996

Centers for Disease Control and Prevention
National Center for Chronic Disease Prevention and Health Promotion
Division of Cancer Prevention and Control
4770 Buford Highway NE, Mailstop K-57
Atlanta, GA 30341-3724
Cancer Information Service
National Cancer Institute
1-800-4-CANCER
(For information on skin cancer)

Links to UVR related web sites

Photobiology OnLine
A joint presentation of the American and European societies of photobiology. UVR topics are covered as well as other areas of photobiology. **This** is a very rich resource for anyone who is interested in any aspect of photobiology**.**

Institute of Medical Physics
This site provides abstracts for several papers on UVR topics from the Institute for Medical Physics in Vienna. There are also useful links to other UV sites.

NASA
A UVR and ozone depletion "primer" from NASA. I recommend this as the best place on the net to start if you are relatively unsophisticated about these issues.

NOAA/EPA experimental ultraviolet exposure index
This site contains information about an exposure index which is being developed which it is claimed will provide improved forecasts of potential UV exposure. The site contains links to other sites with technical information related to UV monitoring and exposure forecasting.

NIWA/Lauder. New Zealand
This is a brief review of UVR topics from New Zealand where they are particularly interested in this topic. Some nice graphs and a brief but possibly useful bibliography.
CIESIN.HH
This site contains several reports on UVR and ozone issues with links to other reports. Topics covered include UVB and skin cancer, UVB and ocular damage and UVB and immune system supression. The papers are brief but they should provide a good way to gain an initial understanding of the topics.

CIESIN.OZ
This is a useful bibliography of papers on UVR and stratospheric ozone issues. The complete text of some of the papers is available online.

GCRIO
And still another brief review of UVR and related health topics with a bibliography.

Parson's review of Rav and Guzzo
This is a "critical analysis of two chapters from: _Environmental Overkill~ by Dixy Lee Ray with Lou Guzzo. Regnery Gateway Press, 1993" written by Robert Parsons. Parsons effectively demolishes the flimsey arguments offered by Ray and Guzzo to the effect that there is no good evidence for ozone depletion or UVB increase. This page gets my vote for the most valuable UVR resource on the web at the present time.

Skies above Foundation
The perspective of an environmental group headquartered in Victoria, B.C., Canada.

EXPERIMENTAL UV INDEX

Qs & As FOR METEOROLOGISTS

This document is intended to help meteorologists answer basic questions about the experimental UV Index, the new product from the National Weather Service (NWS). This information may help you field the many important concerns and questions the public may have.

Q: What is the experimental UV index?

A: The experimental UV Index adjusts solar radiation by a number of atmospheric effects to forecast UV exposure levels in major cities around the country. For the first year, the UV Index will be released on a limited experimental basis.

Q: How do clouds affect predicted levels of UV radiation?

A: The effect of clouds on UV levels depends on the degree of cloudiness. Although thick overcast will reduce ultraviolet, thin overcast scattered clouds may not reduce UV levels. As with any forecast, local variability may change actual levels experienced. For this reason, a useful rule of thumb to offer your audience is that, whatever the day's prediction, they should protect themselves against overexposure to sunlight whenever they can see their shadow when outdoors.

Q: How does the forecast consider altitude?

A: UV levels increase with altitude because there are fewer atmospheres to attenuate the radiation. This factor is considered in the forecast for specific cities. In general, UV levels rise 2% for every 1,000 foot rise in altitude or 1 index unit for every 4 thousand feet in summer.

Q: How do reflective surfaces affect the predicted index level?

A: Snow, sand and water are all reflective surfaces and will intensify UV exposure to varying degrees. Grass reflects from *2.5-3%,* sand 20-30%, snow and ice 80-90%. Depending on the angle of reflection, water can reflect up to 100% of rays striking the surface. Seasonally appropriate messages may help people be aware that, for example, sand and water at beaches can increase the reported level considerably.

Q: How much do UV levels vary by season?

A: Seasonal variability can be quite high. Late spring to summer typically produces the highest UV levels, while in the early winter, levels are lower.

Q: If I go on vacation in the Bahamas, how much more UV can I expect to be exposed to?

A: Generally speaking, the closer you are to the equator, the higher will be the level of UV you will be exposed to. Because you may not be used to such high levels, it makes particularly good sense to cover exposed areas and wear sunglasses on vacation. Even during the winter, you can be badly sunburned at lower latitudes.

Q: That affect does the ozone layer haye on reported UV levels?

A: It is well known that atmospheric ozone decreases the amount of incident UV. However, the exact impact of ozone depletion, or other local effects, including haze, aerosols, et cetera, is not yet fully understood.

June 1 994N () AAIF~A 430-F-94-020

BULLETIN OF SAMPLE PUBLIC HEALTH MESSAGES TO ACCOMPANY UV INDEX

Composite Health Messages for Five Exposure Categories

Minimal. An Index reading of O to 2 means minimal danger from the sun's UV rays for the average person. Most people can stay in the noon sun for up to one hour without burning. Persons with extra sensitive skin or infants should always be protected from prolonged sun exposure. (It is appropriate in some locations to remind people that at nearby locations where there is snow cover or water that reflected UV may be quite strong. Precautions such as sunscreen and sunglasses give protection from reflected UV.)

Low. An Index reading of3 to 4 means you may be at risk of skin damage from the sun's rays, since many people can experience sunburn in 45 minutes. Wearing a hat with a brim and sunglasses will protect your eyes. Use of a sunscreen will enable you to stay in the sun longer.

Moderate. An Index reading of 5 to 6 means you may be at some measurable risk of skin damage due to the sun. For many people, unprotected exposure can result in a burn in only 30 minutes. A sunscreen of at least 15 is recommended. Wear a hat and sunglasses to protect your eyes.

High. An Index reading of7 to 9 means you may be at high risk of harm from unprotected exposure to the sun. Enjoy your daily activities by liberally applying sunscreen of at least *15,* and by wearing a hat with a brim and sunglasses. Limit your time in the sun during midday since at noon many people can burn in less than 15 minutes.

Very High. An Index reading of 10 and above means you are at maximal risk of harm from unprotected sun exposure. Try to avoid being out in the sun during midday hours, from 10:30 to 3:30 PM because the length of time to burn may be as little as 10 minutes without protection. Wear protective clothing and use a sunscreen of at least 15 liberally and often. Always wear a hat with brim and sunglasses. Outdoor workers are at special risk.

Using Your Shadow to Estimate UV Intensity

If it is not heavily overcast, UV exposure changes during the day. Providing a simple rule-of-thumb for the UV intensity on a sunny day may encourage people to take more precautions when their exposure is likely to be the greatest. (Some caution is needed, because people can experience significant UV exposure on a cloudy day, when they cannot see their shadow.)

- Simple rule-of-thumb: On a sunny day, one way to judge how much exposure to UV rays you are getting is to look for your shadow. If you see your shadow, then you are being exposed to UV. The longer your shadow (in the early morning and late afternoon), the less exposure to UV rays. The shorter your shadow (around noon), the more you are being exposed unless you are taking precautions.

Health Messages Addressing Specific Health Risks or Prevention Actions

Sunscreen and other protective measures

- A **sun block** prevents sunburn and minimizes suntan by reflecting all UV rays. Sun blocks offer the most protection from burning solar rays. A sun block is a good choice for protecting the nose and the rims of the ears. (For Index 5 and above)

- Use of a **sunscreen** with SPF of 20 to 30 offers substantial protection from sun burning, usually permitting no sun tanning. (For Index 7 and above)

- Choose a broad spectrum sunscreen which filters out UVA and UVB. (For Index 3 and above)

A sunscreen which provides an SPF under 4 offers the least protection. If you rarely burn and always tan this level of skin protection may be sufficient to help prevent burning and uneven coloration. (For Index 3 and above)

- High SPF sunscreens protect from burning for longer periods of time than do sunscreens with lower SPFs. (for all index levels)

- Apply sunscreens to all exposed areas of skin including those easily overlooked areas such as the rims of the ears, the lips, the back of the neck and the feet. (For Index 3 and above)

- All skin types need protection from solar ultraviolet rays. Lighter skin types are at the greatest risk of developing skin; but all people are at some risk. Wrinkling, toughening, and aging will happen to all skin types. Sun screens are recommended for everyone. (For Index 7 and above)

- Apply sunscreen liberally. Recommended dose is 1 ounce per application. Reapply every two hours, after being in the water, or after exercising and sweating. Incidental time in the sun could add up to sunburn. Don't forget the time spent walking your dog, window shopping, or jogging on your lunch hour. (For Index 7 and above)

- Don't forget the sunscreen when performing outdoor chores. (For Index 3 and above)

Protective Clothing

- Hats with large brims offer protection to the face, ears, neck and eyes. Hats may be easier than eyeglasses for tots to wear. (For Index 3 and above)

- Tightly woven fabrics afford the most protection against UV rays and tightly woven cotton fabric transmits very little UV rays. UV is transmitted through the holes and spaces in the weave so loosely knit fabrics offer little protection from the burning rays of the sun. (For Index 7 and above)

Sun Avoidance

- Avoid the noon day sun. Typically the amount of exposure at 8 or 4 is only one-third of that at noon. Remember, however, that you can still get sunburn even in the mid afternoon. (For Index 5 and above)

- Seeking shade is a good idea but don't forget that sand, and pavement reflect UV rays even under the umbrella. (For Index 7 and above)

- Skiers remember that snow is a particularly good reflector of UV rays. Wear UV protective sunglasses or goggles. (For winter and early spring)

Eye Protection

- Wearing sunglasses will reduce the amount of rays reaching the eye by filtering upwards of 80% of the rays. (For Index 3 and above)

- Wearing sunglasses protects the lids of our eyes as well as the lens. (For Index 5 and above) Immune Effects

- Use of a lip balm or lip cream containing a sunscreen protects some people from recurrent lip eruptions of herpes simplex type 1 and 2. (For Index 5 and above)

NOAA/EPA ULTRAVIOLET INDEX /UVI/ FORECAST
CLIMATE PREDICTION CENTER NCEP
NATIONAL WEATHER SERVICE WASHINGTON DC
103 PM EST SAT DEC 14 1996

VALID DEC 15 1996 AT SOLAR NOON /APPROXIMATELY NOON
LOCAL STANDARD TIME OR 100 PM LOCAL DAYLIGHT TIME / THE UV INDEX IS CATEGORIZED BY EPA AS FOLLOWS

UV	EXPOSURE LEVEL
0	Minimal
1	
2	
3	Low
4	
5	Moderate
6	
7	High
8	
9	
10 AND GREATER	Very High

FOR HEALTH RELATED ISSUES.. CONTACT EPA AT 1~800-296-1996 OR CDC 404-488-4347. FOR TECHNICAL INFORMATION ON HOW UVI VALUES ARE GENERATED… CONTACT THE NATIONAL WEATHER SERVICE AT 301-713-0622.

CITY	STATE	UVI	CITY	STATE	UVI
ALBUQUERQUE	NM	2	LITTLE ROCK	AR	1
ANCHORAGE	AK	0	LOS ANGELES	CA	3
ATLANTA	GA	2	LOUISVILLE	KY	1
ATLANTIC CITY	NJ	1	MEMPHIS	TN	1
BALTIMORE	MD	1	MIAMI	FL	4
BILLINGS	MT	1	MILWAUKEE	WI	0
BISMARCK	ND	1	MINNEAPOLIS	MN	0
BOISE	ID	1	MOBILE	AL	3
BOSTON	MA	1	NEW ORLEANS	LA	2
BUFFALO	NY	1	NEW YORK	NY	1
BURLINGTON	VT	1	NORFOLK	VA	1
CHARLESTON	SC	2	OKLAHOMA CITY	OK	1
CHARLESTON	WV	2	OMAHA	NE	1
CHEYENNE	WY	1	PHILADELPHIA	PA	1
CHICAGO	IL	1	PHOENIX	AZ	3
CLEVELAND	OH	1	PITTSBURGH	PA	1
CONCORD	NH	0	PORTLAND	ME	1
DALLAS	TX	1	PORTLAND	OR	0
DENVER	CO	2	PROVIDENCE	RI	1
DES MOINES	IA	1	RALEIGH	NC	2
DETROIT	MI	1	SALT LAKE CITY	UT	1
DOVER	DE	1	SAN FRANCISCO	CA	2
HARTFORD	CT	1	SAN JUAN	PU	7
HONOLULU	HI	6	SEATTLE	WA	0
HOUSTON	TX	1	SIOUX FALLS	SD	1
INDIANAPOLIS	IN	1	ST. LOUIS	MO	1
JACKSON	MS	2	TAMPA	FL	3

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