Novel Introduction of Spice and Fruit Butters and Oils in Cosmetic Applications

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Abstract

The relationship between food and health has been duly recognised throughout recorded history. Herbs, roots and berries with health beneficial properties were known thousands of years ago and have been continuously utilised to promote sound health and to combat diseases. In more recent times, it has been discovered that these reliable products are the source of vitamins, antioxidants and other health related essential nutrients. This paper presents unique developments of natural products employing spices and fruits to design extremely effective oils and butters for cosmetic applications. These products are internally stabilised to enhance the shelf life of the final applications.

Introduction

Spices and herbs have played a dramatic role in the development of Western Culture. Spices are seasoning for food that come from bark, buds, fruit or flower parts, roots, seeds or stems of various aromatic plants and trees. Herbal medicines rarely have significant side effects when used appropriately and at suggested doses. Spices play an important role in the human diet. A diet containing all the nutritive components required by the body may be quite insipid without spices. The term spice or condiment applies to 'such natural plant or vegetable products or mixtures thereof, in whole or ground form, as are used to impart flavour, aroma and piquancy to and for seasoning food'.

Ayurveda medicine prescribes more that 700 plant-based medicines that contain spices and food additives to encourage good health. Good quality clinical research to support the reputed effects of many herbs is extremely lacking.

Of the various spices available, only nine spices *viz*, pepper, ginger, cloves, cinnamon, cassia, mace, nutmeg, pimento and cardamom together contribute to over 90% of the total world trade in spices. The major spices of India include pepper, cardamom, ginger, turmeric and chillies, forming about 85% of the total export of spices.

Turmeric (*Curcuma longa*) belongs to the ginger family. Of about 70 turmeric species *C. longa* is the most important cultivated variety (96% of the cultivated area), whereas *C. aromatica* accounts for 40% of the area under cultivation. The cured turmeric has a sweet fragrance and is largely used to make several cosmetic products.

Turmeric Plant (*Curcuma longa*)

The turmeric rhizomes, like ginger, are cured for the development of the colour and aroma. The rhizomes are cooked in water, limewater or sodium bicarbonate solution and the soft, cooked rhizomes are sun-dried, cleaned and polished mechanically in rotary drums. The cured and finished product is brittle and has a striking yellow colour.

Component	%
Moisture	5.8 %
Protein	8.6 %
Fat	8.9 %
Carbohydrates	63.0 %
Fibre	6.9 %
Ash	6.8 %
Calcium	0.2 %
Phosphorous	0.26 %
Iron	0.05 %

Table 1. Nutritional Composition of Indian Turmeric [1]

Vitamin	mg/100g
Thiamin	0.09
Riboflavin	0.19
Niacin	4.9
Vitamin A	175 IU/100g

Table 2. Vitamin Content of Turmeric (mg/100g)

Turmeric gives 1.5% essential oil on steam distillation. It consists of 56% sesquiterpene ketones (termerones) and 9% tertiary alcohol. An oleoresin containing all the aroma and flavour of turmeric can be obtained on solvent extraction, followed by removal of the solvent. It has a great value in the food and pharmaceutical industries. Curcumin pigment gives turmeric its yellow colour.

Turmeric powder is used as a flavouring agent and a colourant in many foods to give them agreeable flavour and colour. It is a constituent of any curry powder and prepared mustards. It is also used for dyeing wool, silk and cotton. Since turmeric is an antioxidant and has germicidal properties, it finds a use in cosmetics and medicines.

There is a long list of skin care benefits associated with turmeric, including the treatment of acne, blemishes, dark spots and hyperpigmentation and other skin conditions such as eczema and psoriasis. It helps heal and prevent dry skin and to slow the skin ageing process and is used to diminish wrinkles, keep skin supple and improve skin elasticity. This sunny, bright spice is also being used as an ingredient in sunscreens. It is used daily by East Indian women as a facial cleanser and exfoliant and also as a facial hair reducer.

In order to introduce curcumin in cosmetic products, we have recently designed turmeric butter which contains around 5% of the tetrahydro curcuminoids, the active molecule of turmeric. The analytical characteristics of this product, which is based on soft shea stearin as base butter, are as shown below in Table 3.

Product Code, INCI Name and CAS No.		
Product Code	: 901074	
INCI Name	: *Curcuma longa* Extract	*Butyrospermum parkii* Kernel Fat
CAS no.	: 84775-52-0	91080-23-8
Specifications		
Organoleptic:		
Appearance	: Solid Butter	
Odour	: Characteristic Odour	
Colour	: Pale Yellow	
% Free Fatty Acid (as Oleic Acid)	Max 1.00	
Iodine Value	40 - 50	
Peroxide Value (meq/kg)	Max 5	
Saponification Value	188 - 203	

Table 3. Characteristics of Turmeric Butter

Oxidation of Oils and Fats

The oil or fat content of a cosmetic product can vary from 2-15% in the case of body lotions and creams, while it can be 100% in the case of massage oils. It is very important that only the best quality oil or fat is used in any cosmetic formulation. 'Quality' of a commercial oil or fat is very often measured through its oxidative stability. Oxidation of a lipid is a very common and serious problem for any fat containing product, food or cosmetic. Characteristic changes linked with oxidative degradation of oils and fats include development of malodours, unpleasant tastes and might lead to change of colour, increase in viscosity, specific gravity and solubility. The mechanism of autoxidation has been postulated by many authors. Autoxidation is a natural free radical process between molecular oxygen and the unsaturated fatty acids of an oil, which leads to the formation of short lived hydroperoxides (primary oxidation products). The hydroperoxides readily break down to form aldehydes, ketones and other hydrocarbons. These secondary oxidation products impart rancid odour and taste. One way of preventing autoxidation is the addition of antioxidants.

The interest of the food and cosmetic industry in phenolic antioxidants is primarily related to the extension of the shelf life of the various consumer products. In the present global market, there is hardly any food or cosmetic product, semi-finished or finished, which does not contain any added preservatives. The antioxidants used are mostly synthetic,

namely butylated hydroxyanisole (BHA), ascorbyl palmitate, tertiary butylhydroxyquinone (TBHQ) etc. But the consumers' awareness of the possible toxic side effects of synthetic antioxidants and preference for natural additives, has led to more detailed investigations and applications of natural herb extracts as antioxidants.

This paper highlights two highly efficient ways of stabilising oils and butters without the application of synthetics. Using supercritical CO_2 and other solvents such as ethanol for extraction, the components of rosemary extracts (*Rosmarinus officinalis*) have been well studied. The composition of rosemary extract is quite complex, consisting of a mixture of phenolic acids and diterpenes. The main antioxidative effect of rosemary extracts come from three phenolic compounds namely carnosic acid, carnosol and rosmarinic acid, of which over 90% of the antioxidant activity is from carnosic acid and carnosol. Flavonoids, particularly flavones, have also been identified in rosemary extracts. Apart from the antioxidant activity, there are mentions of antimicrobial, antiviral, antimutagenic activities of rosemary extracts.

Despite these various benefits, application of rosemary extracts often incorporates a distinctive flavour, characteristic of rosemary. This limits the use of rosemary extracts to a large extent in food and cosmetic products. Using rosemary extracts, we have developed a process called 'internal stabilisation' by which all exotic butters and natural oils are protected against oxidative deterioration [2,3].

The butters and oils used for our study of internally stabilised products are shea butter, mango butter, sal butter or shorea butter, evening primrose oil and borage oil. Another way of protecting oils and butters is by external addition of rosemary extracts. The oils and butters used for this are camelina, flax, blackcurrant, evening primrose and borage and mango butter and shea butter.

Methods

Oil stability index (OSI) was determined as a tool to judge oxidation stability. The instrument chosen for determining OSI was a Rancimat 743. The principle of Rancimat analysis depends on the measurement of an increase of electrical conductivity by volatile carboxylic acids generated in the oxidising oil sample. The temperature was maintained at 120°C for exotics and 80°C and 100°C for liquid oils. The air in-flow was maintained at 18 lit / hr and the sample size was 3.0 ± 0.05 gm.

Internal Stabilisation

The data obtained, induction periods (IP) from the Rancimat tests, were plotted as a function of time to obtain bar diagrams which show the relative increase of oxidative stability for each of the test samples. The results are divided into two groups, namely the exotic butters and natural oils.

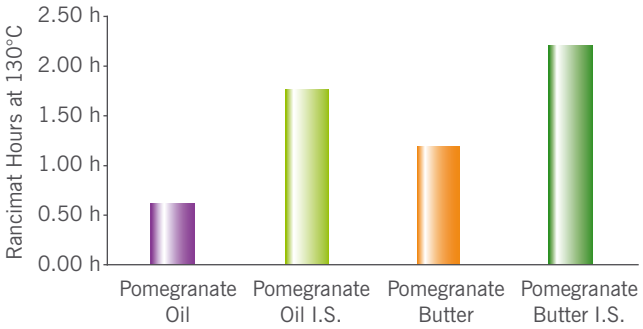
Fruit Butters and Oils

Pomegranate seed oil is an extremely rich oil with powerful antioxidant properties and it can be extensively used in several cosmetic applications such as soaps, massage oils, facial care, body care and cosmetics. We have successfully extended our internal stabilisation technique to all our fruit oils and butters to provide the following benefits:

- prolonged shelf life of the cosmetic products in which they are used
- stronger antioxidant properties compared to natural tocopherols
- strong antimicrobial properties which can remove the amount of chemical preservatives in the final formulation of the skincare products
- strong anti-inflammatory and anti-ageing properties
- no need to add antioxidants in the formulation of the final cosmetic product
- adds a more 'natural' label to the product.

Pomegranate

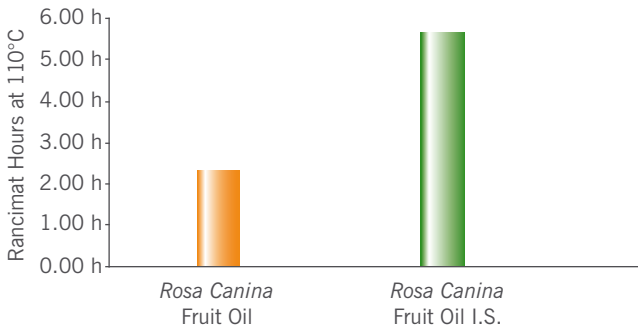
Figure 1 shows a clear increase of oxidative stability of pomegranate oil and butter at 130°C which can be translated to an increase of 12-18 times at an ambient temperature of 20°C.



Protection Factors: Pomegranate Oil 2.85, Pomegranate Butter 1.87
Figure 1. Internal Stabilisation of Pomegranate Oil and Butter

Rosa Canina Fruit Oil

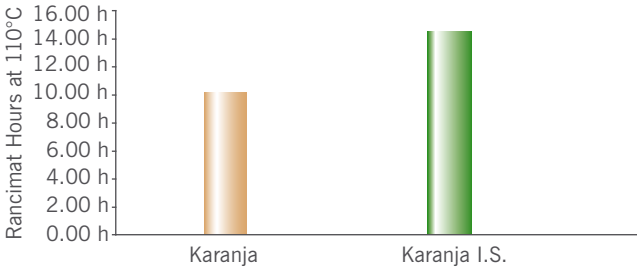
Rosehip oil is rich in essential fatty acids, vitamins and minerals. It has remarkable antioxidant properties and helps in improving skin elasticity, regenerate skin cells, slow down premature ageing, reduce the formation of wrinkles and scarring. It is highly desirable in the use of formulations for damaged or maturing skin. Figure 2 clearly shows a dramatic increase in oxidative stability providing extremely high life extension of the product in question.



Protection Factors: 2.44
Figure 2. Internal Stabilisation of *Rosa Canina* Oil

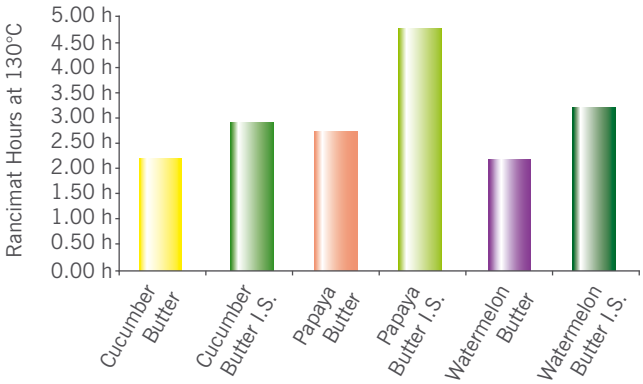
Karanja Oil

Karanja oil is obtained from the seeds of Pongam tree and contains insecticidal and antiseptic properties and is commonly used in applications such as body oils, lotions, soaps, hair oils, shampoos, garden care and pet care. Figure 3 reveals extensive oxidation stability improvement.

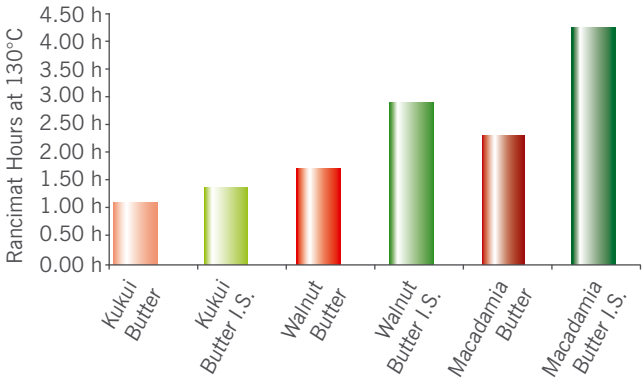


Protection Factor: 1.43
Figure 3. Internal Stabilisation of Karanja Oil

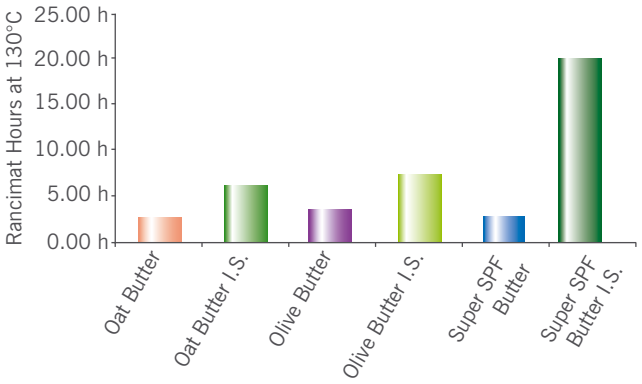
We have developed a series of fruit butters for wider application in cosmetics using the above described principles. The results shown in the following figures (4-6) show the applications of mild internal stability of the ingredients, which should be successfully applied in unique cosmetic formulations.



Protection Factors: Cucumber Butter 1.31, Papaya Butter 1.73, Watermelon Butter 1.49
Figure 4. Mild Internal Stabilisation of Cucumber Butter, Papaya Butter and Watermelon Butter



Protection Factors: Kukui Butter 1.22, Walnut Butter 1.68, Macadamia Butter 1.83
Figure 5. Mild Internal Stabilisation of Kukui Butter, Walnut Butter and Macadamia Butter



Protection Factors: Oat Butter 2.37, Olive Butter 2.15, Super SPF Butter 7.11
Figure 6. Mild Internal Stabilisation of Oat Butter, Olive Butter and Super SPF Butter

We have successfully applied this technology to a final spray product based on coconut oil and studied the oxidation stabilities of the oil and the products at ambient temperature. These results (Figures 7-9) clearly demonstrate that our internal stabilisation technology totally arrests oxidation and thus allows a higher inclusion of lipid materials in cosmetic formulations. Further work is in progress for innovative development of new and exotic products for cosmetic formulations.

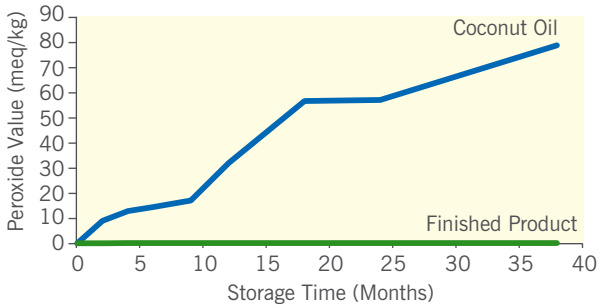


Figure 7. Stability of Finished Cosmetic Product, Peroxide Value

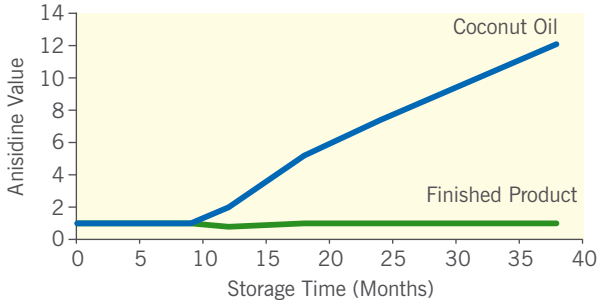


Figure 8. Stability of Finished Cosmetic Product, Anisidine Value

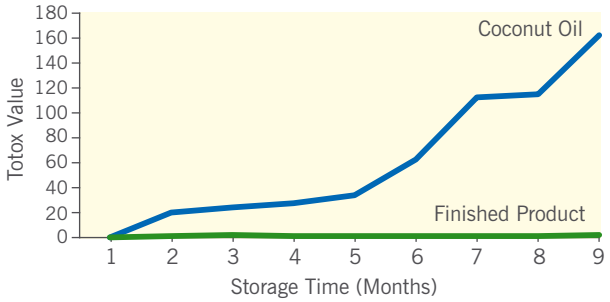


Figure 9. Stability of Finished Cosmetic Product, Totox value

Conclusion

This paper clearly elucidates the wider application of spice and fruit butters and oils for various cosmetic applications. These new ingredients will provide cosmetic chemists new avenues of research in formulating beauty products for better and safe health.

References

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Authors' Biographies

Professor, Dr. Vijai K. S. Shukla is President of International Food Science Centre A/S and also Adjunct Professor in the Department of Food Science and Nutrition, at the College of Food, Agricultural and Natural Resource Science, University of Minnesota, St. Paul, Minneapolis.

Research interests

Professor, Dr. Vijai K. S. Shukla is the author of nearly 110 original scientific publications, 12 invited review papers, 15 book chapters in the areas of biochemistry, human nutrition, cosmeceuticals, neutraceuticals, enzymology, modern analytical techniques for the separation of lipids and proteins. He is also the editor of six books.

Specialisation

Professor, Dr. Shukla's research interests have ranged from physical phenomena to mechanism of autoxidation, isolation

of lipids, spectral phenomena related to lipids, modern analytical methodology and involvement of essential fatty acids in health and diseases such as multiple sclerosis and Batten's syndrome and he has also shown essential fatty acid deficiency in multiple sclerosis and Batten's disease. These were related with glutathione peroxidase activity and antioxidant requirements in these diseases. He has also analysed arctic diet in Greenland Eskimos and compared them with Danes, elucidating some of the mechanism of coronary heart diseases in these population groups. In his research work Professor, Dr. Shukla employs modern analytical methodology in order to resolve various scientific problems.

Accomplishments in Industrial Applications

Professor, Dr Vijai K. S. Shukla has been working in the area of confectionery product development for the last three decades. He has a special expertise in cocoa butter, milk fat, cocoa butter equivalents and cocoa butter substitutes based on modern concepts of recipe engineering. He has always applied scientific principles to upgrade or modify existing production to achieve super quality products. Some of his major achievements are as follows: during 1996 Professor, Dr. Shukla established a brand new refinery in The Netherlands and has successfully demonstrated that total oxidation in bulk oils can be completely arrested and that speciality fats delivered to the customers will be of extremely fresh quality. These deliveries were in the scale of 500-1000 MT per shipment. A proper research approach clearly shows that it is possible to provide uplift to large scale production through extreme care, taking the help of nitrogen as inert gas and stainless steel in the production system. A number of international press articles presented these developments.

For the last two decades Professor, Dr. Shukla's research has focused on the quality of encapsulated fish and vegetable oils. He has successfully demonstrated that it is possible to produce ultra refined fish oil with extreme low peroxide value and anisidine value. This oil is already in commercial production. Having produced the above mentioned oils it is of the utmost importance to keep these oxidation values extremely low, therefore he has designed several natural antioxidant systems for general nutrition as well as cosmetic oils. This natural antioxidant system is 50 to 60 times more powerful than existing available antioxidants. He has recently developed a novel designer oil called Nutridan containing very high amounts of essential polyunsaturated fatty acids. The oils used are of vegetable origin and extracted by physical means and are thus totally solvent free. Nutridan provides not only balanced essential fatty acids but also a high dosage of natural antioxidants which are extremely beneficial for better health.

Extraordinary Achievements

Professor, Dr Vijai K. S. Shukla has appeared in: Who's Who in the World, 12th edition 1995-96; 2000 Outstanding Scientists of the World; 2000 Outstanding Intellectuals of the 20th Century; The Barons 500 Leaders for the new Century; The Cambridge Blue Book 2005. In 1996 he was awarded the American Oil Chemists' Society (AOCS) prestigious Herbert Dutton Award for pioneering contribution in Lipid research presented in Indianapolis. The title of the award lecture was 'Chocolate - The Chemistry of Pleasure. In 2002 he received the American Oil Chemists' Society prestigious Stephen S. Chang Award presented in Montréal, Canada. The title of the award lecture was 'Chocolate – Friend or Foe?' This award is given to a scientist who has achieved decisive accomplishments in basic research and the knowledge that the person has produced must have been utilised by industries for the improvement or development of food products related to lipids. And in 2005 he was made an AOCS Fellow in recognition of his achievements in science and appreciation for significant service to the AOCS.
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Mr Søren Nielsen studied at Odense University Hospital, Odense, Denmark. He is a Research and Development Technician at ICSC. He specialises in product innovation, technology of fats, analytical evaluation and recipe engineering programmes. He also specialises in refining technologies of oils and fats and he has more than 30 years of experience in lipid research.