

Acceptance of irradiation in the cosmetic industry

The Paradigm Shift to the Application

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Abstract

There are some Brazilian companies from the personal hygiene, cosmetics and perfumery sector whose have been incorporating natural ingredients from the Brazilian biodiversity in its products. However, the experience from dietary supplements or herbal medicines showed that being natural is not equivalent to *being safe*. Adverse dermal effects of botanicals include irritation, sensitisation, phototoxicity and immediate-type allergy. The key issue of the safety assessment of botanical ingredients in personal care products (PCP) is the phytochemical characterisation of the plant source, data on contamination, adulteration and hazardous residues. Pragmatic approaches for quality and safety standards of botanical ingredients are needed; consumer safety should be the first objective of conventional and botanical PCP ingredients. Another kind of hazard in natural cosmetics products with high water content are at a risk of being contaminated by microorganisms that can alter the composition of the product or pose a health risk to the consumer. Pathogenic microorganisms such as bacteria or fungi are frequently found in contaminated cosmetics. Microbiological contamination can spoil the product or the microorganism may be pathogenic (causing diseases) and hence potentially harmful to the user. In order to avoid contamination of cosmetics, the manufacturers add preservatives to their products and the concentration of the same preservative in similar products varies greatly, and this may indicate that some cosmetic products are over preserved. It can explain the increase of allergy to preservatives in some consumers, one of the main reason for contact eczema caused by cosmetics. As development and elicitation of contact allergy is dose dependent, over preservation of cosmetics potentially leads to increased incidences of contact allergy. Very few studies have investigated the antimicrobial efficiency of preservatives in cosmetics and how the cosmetic industry can innovate to clean the raw material before the manufacturing using natural plants ingredients, that can be contaminated with bacteria or fungi, and the same time reduce the level of chemicals ingredients. However, not all forms of technological innovation are immediately accepted in the industry in general, in some of its departments. The aim of this study was to analyze the degree of acceptance of a new technique for decontaminating raw material of innovation and technology department of a large cosmetic industry. The reason for the resistance in the implementation of the new form of decontamination was the lack of knowledge about the technique, using a physical method (gamma radiation), the lack of partnerships with companies specializing in radiation treatment, treatment doses of raw material and awareness of employees about the benefits of this technique. After meeting with the responsible staff and one workshop for other employees about the subject, it was applied to participants an evaluation form on the acceptance of the new method. In a scale of

acceptance with a maximum score of 5, this work demonstrated a mean value of 4.52, demonstrating that the project was successful.

Keywords: Microorganism, raw material, gamma radiation, acceptance, new method.

Introduction

Humans for time immemorial have used cosmetics, an industry dominated by a few major players. The cosmetic industry is a very lucrative, innovative, and fast paced industry where product innovation is the key to success. Each of these cosmetic companies is unique. They each offer something different to the industry; selling method, marketing strategy, product line, and distribution channel. The industry trends indicate that the future of cosmetics may move towards more joint ventures between drug companies, cosmetic companies and nutritional/food companies as cosmetic companies look for new ways to be innovative [1, 2].

In analyzing the issue of corporate strategies in this new world scenario, Mintzberg and Quinn [3] argue that there is a constant need of being perfecting your business enterprises. This process of perfecting business can be done through the development of its products within its structure, its market development through new segments, new channels or new geographic areas or placing the same products more vigorously for the same markets.

There are some Brazilian companies from the personal hygiene, cosmetics and perfumery sector whose have been incorporating natural ingredients from the Brazilian biodiversity in its products. However, the experience from dietary supplements or herbal medicines showed that being natural is not equivalent to *being safe*. Adverse dermal effects of botanicals include irritation, sensitisation, phototoxicity and immediate-type allergy. The key issue of the safety assessment of botanical ingredients in personal care products (PCP) is the phytochemical characterisation of the plant source, data on contamination, adulteration and hazardous residues. Pragmatic approaches for quality and safety standards of botanical ingredients are needed; consumer safety should be the first objective of conventional and botanical PCP ingredients. Another kind of hazard in cosmetics products with high water content are at a risk of being contaminated by microorganisms that can alter the composition of the product or pose a health risk to the consumer [4].

Pathogenic microorganisms such as bacteria or fungi are frequently found in contaminated cosmetics. Microbiological contamination can spoil the product or the microorganism may be pathogenic (cause diseases) and hence potentially harmful to the user. In order to avoid contamination or to preserve the cosmetics, the manufacturers add preservatives to their products, but allergy to preservatives is one of the main reasons for contact eczema caused by cosmetics. Concentration of the same preservative in similar products varies greatly, and this may indicate that some cosmetic products are over preserved. As development and elicitation of contact allergy is dose dependent, over preservation of cosmetics potentially leads to increased incidences of contact allergy. Very few studies have investigated the antimicrobial efficiency of preservatives in cosmetics, but the results indicate that efficient preservation is obtainable with concentrations well below the maximum allowed [4].

Research Problem, Objectives and Plan

Cosmetic products become easily contaminated by bacteria and fungi, mainly from of raw material, as plants. Containing water, oils, peptides, and carbohydrates, cosmetics are a very

good medium for growth of microbes. All these factors contribute to the fact that cosmetic products need preservation to prevent microbial growth, spoiling of the cosmetic product and potential skin infections [5].

It has been amply demonstrated that inadequately preserved cosmetics can be hazardous to human health. Cosmetics with contaminants are not only unappealing to the eye and smell bad, but they may also be pathogenic resulting in the need for medical attention. Skin infections can result from contaminated body products, especially when applied to cracked dry skin. Most cosmetic products contain water and nutrients for microorganisms to grow and flourish. Our skin carries an abundance of microorganisms in addition to tap water which in turn is not sterile. Often times this water is introduced into products in either accidentally or even on purpose. The most carefully prepared products may become contaminated under these circumstances [5].

Cosmetics are an important cause of allergic contact dermatitis (ACD). Fragrances and preservatives are the two most clinically relevant allergens found in cosmetic products. Patch testing remains the gold standard for identification of causative allergens [6].

Common cosmetic allergens are reviewed. Practical methods of allergen avoidance are also discussed. Adverse reactions to cosmetics can be irritant or allergic and are most often caused by fragrances or preservatives. Preservatives include formaldehyde, formaldehyde releasers, and parabens. Other agents that cause allergy are paraphenylenediamine in hair dyes and toluene sulfonamide formaldehyde resin in nail polishes [7].

Other way to obtain the end product safety, without the adverse reaction of preservatives, is the use of raw material free of microbes (bacteria or fungus) and, therefore, the cosmetic industry can reduce the amount of chemical preservatives. One way to clean naturally contaminated raw material is the use of treatment with ionizing radiation such as gamma radiation. Aquino et al. [8] decontaminated vegetable drugs using doses between 5 and 10 kGy without the phytochemical profile to be changed.

However, alternative technologies are not known or accepted immediately by the leaders of departments of innovation and technology business groups, to ignore the technical, business partners or ignorant for not knowing the cost benefits in production. This is the main point of the research problem

The objective of this work was the application of a workshop to clarify managers responsible for innovation and technology from a cosmetics company in the introduction of nuclear technology in the decontamination of vegetable raw materials used in cosmetics, in order to reduce the use of preservatives chemical and thereby ensure products with a lower risk of allergenic effects to the consumer.

Literature review

Because of their high specific characteristics of active ingredients or excipients (concerning grain size, degree of mineral purity, water content, major and trace element contents, vegetal compounds or microbial contamination) of pharmaceutical and cosmetic products, their safety and stability characteristics are vitally important. There are different pharmacopoeias, rules and regulations affecting the use of these natural products, whose denominations in the

commercial sphere vary significantly. Particular attention is also paid to the different safety aspects associated with their processing, handling and administration [9].

Antignac et al. [4] examined a total of 192 samples, including eight different brands of shaving cream and eight brands of shampoo, for their total aerobic bacterial, coliforms and fungal counts. Shaving creams were more heavily contaminated with bacteria than shampoos. Viable bacteria were not recovered from 57% and 10% of shampoos and shaving creams, respectively. No coliforms were recovered from either the shaving creams or the shampoos; however, *Staphylococcus* spp. were detected in six samples of both shampoos and shaving creams. Some of these *Staphylococci*, were *aureus* type. One isolate of *Pseudomonas aeruginosa* was also detected in a sample of shampoo. The incidence of fungal contamination was much less than the bacterial contamination. No viable fungi were recovered from 88% and 76% of the shaving creams and shampoos, respectively. The majority of the remaining samples, for both products, were contaminated with less than 100 fungal cell/g or ml. The pH of all the tested samples was alkaline (pH 7.2–9), which is well known to inhibit fungal contamination.

Ideally, when looking for a suitable preservative for cosmetics there are many things to consider and one of them is that it should be non-toxic and non-irritating to consumers. In a broad sense, should consider innovation in a company not only technology-based innovations, but also any other type, such as innovations in marketing, distribution, administrative and organizational processes to help gain competitive advantage. In analyzing the issue of corporate strategies, there is a constant need of being perfecting your business enterprises, which can be done through the development of its products within its structure, its market development through new segments, new channels or new geographical areas or placing the same products more vigorously for the same markets [10].

In order to preserve cosmetic products, new technologies are employed in the decontamination of raw materials used to make cosmetics, but new technologies are not always accepted, should the company make a pilot study for the introduction of new methodological concepts in all business sectors. The method of gamma irradiation energy is still unknown to many industrial sectors and the case study proposed in a cosmetics industry, demonstrates awareness and acquisition of knowledge about the new technique with the new method more resistant employees.

Several decontamination methods exist but the most versatile treatment among them is the processing with ionizing radiation. Decontamination by ionizing radiation is a safe, efficient, environmentally clean and energy efficient process.

Irradiation has been used frequently to retard senescence of flowers, in inhibiting the formation of tubers and roots, and the deterioration in control fruits, delaying the ripening thereof in the elimination of insects, decontaminating (pathogens) and sterilization of packaging. In food technology advocates matching techniques for food preservation and in this sense, irradiation is a process that can be used alone or in conjunction with other technologies, such as cooling, heating, freezing and packaging [11].

When used within the limits allowed by law, offer several advantages, namely: does not increase in temperature, leaves no toxic residues, does not significantly alter the appearance,

taste and nutritional qualities of the food, leaving them as close as possible in a natural state. In financial terms, the use becomes economically viable, both as regards the cost of the operation as to the durability of perishable products, it increases the shelf life of stored grain, giving the producer the option to market it after the period of peak season, thus achieving, best prices [12, 13, 14].

The high-frequency electromagnetic radiation (high energy photons) are represented by X-rays and gamma rays. The ionizing radiation inactivates the food spoilage organisms such as bacteria, molds, yeasts [15].

The parameter used to measure the radiation is based on the amount of energy deposited in the irradiated material, referred to as absorbed dose. The unit dose of absorption is adopted Gray (Gy) where 1Gy is equivalent to absorption of 1 joule / kg [16, 17].

Irradiation is particularly valuable as an endproduct decontamination procedure. Radiation treatment at doses of 2-7 kGy (depending on condition of irradiation and the product) can effectively eliminate potentially pathogenic nonsporeforming bacteria including both long-time recognized pathogens such as *Salmonella* and *Staphylococcus aureus* as well as emerging or "new" pathogens such as *Campylobacter*, *Listeria monocytogenes* or *Escherichia coli* O157:H7 (Farkas, 1998). Ionizing radiation is a process that can be used to reduce the population of pathogens on raw sprouts [18, 19].

Developing the research model

Research Design and Data Collection

In order to introduce the use of a new technology in the decontamination of plant raw materials employed in the cosmetics industry, it was necessary to carry out a workshop on the process of radiation, with two consulting experts, in the form of speech for three hours. Two experts in the field were invited by the department of technological innovation cosmetics company, one representing a company providing related to treatment by gamma radiation and other services researcher with expertise in applied in decontaminating raw materials plant and microbiology research.

The workshop was prepared for 100 employees and 29 participants completed an evaluation form on the acquisition of knowledge about the method of sterilization by gamma radiation. The board 1 shows the topics covered and cosumed on workshop.

Elucidate the reason for the irradiated product is safer and does not become radioactive.	20 minutes
Legislation and technical regulations	10 minutes
How is the process of managing products to be irradiated in commercial irradiation plant.	20 minutes
Which are the partner companies providing this type of technology and types of customers and products	10 minutes
Safe sterilization and bioburden reduction process	20 minutes
Why the treatment allows that the product can be used or consumed immediately after application.	20 minutes

It is economically feasible for some types of materials and does not change the temperature of the treated items.	20 minutes
It has high penetrating power, enabling the processing of products in their final packaging, avoiding any manipulation.	10 minutes
Compatible with thermosensitive products and is suitable for fresh products, chilled, frozen.	10 minutes
What kind of bacteria or fungus is found (pathogens) in vegetable raw material and cosmetics and the risks to the consumers health	20 minutes
Where the dose of choice for eliminating microbial contamination	10 minutes
To elucidate doubts and questions	10 minutes

Data analysis and model testing

After the meeting, an evaluation form with 12 questions was applied to a part of the group of 29 participants to analyze the change of view on the new method, showed in board 2. These data will be used before authorization proceeding of managers.

Board 2. Results of score of questions about the workshop “Use and benefits of gamma radiation”:

Questions	Score (0-5)	Questions	Score (0-5)
1. Subject domain	4.72	7. Contributes to efficient work	4.45
2. Interaction with participants	4.48	8. Contributes to the implementation of the content	4.21
3. Promotes the socialization of knowledge	4.66	9. Facilitate understanding of the content	4.31
4. Language: Facilitated understanding of the content	4.62	10. Foster information sharing	4.31
5. Added knowledge	4.69	11. How I perceive my performance / utilization as a participant	4.31
6. Applicable in daily	4.48	12. The way I organized my time to attend the course	3.97
Overall evaluation of the workshop			4.52

Discussions and Conclusion

The degree of satisfaction of employees was high after the workshop and some of them reported a 100% of satisfaction. Other comments were observed in this group (Board 3):

Board 3. Some observations about the workshop “Use and benefits of gamma radiation”:

Participant 1	"Excellent, I was surprised by the information passed since I changed my way of thinking after the lectures.
Participant 2	I was against irradiation and realized that there are many benefits, congratulations. Very good."
Participant 3	"Two very good speakers. The second speaker talked a lot about fungi, I think it might have been flagged but very nice too."
Participant 4	"I suggest comments on how the pharmaceutical and cosmetics industries are applying irradiation MPX finished product."
Participant 5	"Overview subject well covered and well understandable technical part."
Participant 6	"Very good! Made it clear issues irradiation."

The conclusion is that, before introducing a new technology in an industrial process, a meeting of officials and researchers is an important way to understand the changes and adapt to new methodologies. Is achieved also through this new partnership with companies and universities are sealed.

Further research

The next step of this consultancy is monitoring the pilot project of the choices of different doses of radiation on vegetable raw materials used in the preparation of some cosmetics.

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