SUSTAINABLE DEVELOPMENT OF COSMETIC PRODUCTS IN THE FRAME OF THE LABORATORY MARKET

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The main objective of the current study is to highlight sustainable development from the perspective of the cosmetics industry producing 'eco-friendly' products. In the last decades an enhancing interest is being experienced towards sustainable development among cosmetics manufacturing companies, scientific research and development (R & D) laboratories as well as green consumers in the need for natural products safer for health and less toxic for the environment. Several international studies show that cosmetic products formulated with natural ingredients developed by cosmetic industry has a higher annual market growth than for synthetic products. R & D puts special focus on new innovative technologies in green cosmetic products to meet the frequently updated requirements of regulations in compliance with the current legislation. Scientific laboratory market has an increasing importance to evaluate natural and organic raw materials. In this work the authors attempt to focus on the growing importance of research activities to sustainable cosmetics production in life cycle assessment methodology. Naturally, the conceptual scope and extent of this study do not permit all the possible issues to be examined from every aspects due to lack of data, thus it will be endeavored to point out merely the most relevant considerations in the field of cosmetic industry.

Keywords: cosmetic industry; laboratory market; sustainability

Introduction

Social and economic importance of natural resources is unquestionable at all times from the aspect of humanity. "Efforts to satisfy the constantly changing demands for quantitiy and quality accompanied human history as an essential motivational factor." (Bora, Korompai, 2003) For decades the reasonable management of natural resources has an emphasized function in the social and economic procedures. In the early periods of economics natural resources were considered as permissible goods exposed unlimitedly to the society. As a consequence of the intensified production and growing consumption in the 20th century, the accelerated pace of population growth increased the utilization of natural resources exponentially. Society's, and mainly the economy's intensifying intervention into nature caused irreversible processes in many cases. Economical management of resources against wasteful and careless utilization – which is able to protect the decrease of biodiversity – became an essential topic on corporate, national, regional and global levels. United Nations in its many programs pays particular attention to key questions related to sustainable development such as the decreasing of the emission of greenhouse effect gases, protection of forests, saving and caring of biological diversity and last but not least the management of energy resources (Szlávik, 2013).

Sustainable development as a concept – following the UN's Brundtland report dated in 1987 – became widely popular at the end of the '90s. According to its interpretation it is necessary to reach or create a balance and harmony between soceity's material demands, growing population and utilisation of natural resources in focus of minimizing the pollution (Tenk, 2010). The Brundtland report – Our Common Future – defines sustainable development as follows: Sustainable development is a sort of development which ensures the satisfaction of present generation's demands without the threat of endangering future generations' chances to satisfy their demands (Brundtland committee, 1987). Sustainability is based on the balanced consideration of three pillars of economic development, social responsibility and environmental protection dimensions thoroughout globalization. Duran et al. established in his publication that although little is known about the drivers of sustainablity, the main one is innovation, which can be technological, concerning products, process or non-technological, such as marketing, organisation.

The current study has two main objectives. It performes a scientific literature overview on sustainable green, natural and organic cosmetic products, regulations as well as customer behaviour. It also presents the growing needs and importance of analytical laboratory measurements in the research field for cosmetics products. The paper is structured as follows: the first section gives a general overview on the general concept of sustainability, while in the second section sustainability is reflected from the perspective of the cosmetics industry focusing mainly on 'eco- and environmental-friendly' green products, green customer behavior as well as cosmetic regulation, legislation. The third part highlights the important role of the research and development laboratories.

Material and methods

Most relevant scientific publication have been collected and used in the study, proceeding towards scientific literature synthesis throughout the work as methodology. Furthermore examination of the set of hypothesis discussed in the following chapter for the different topics in the article was carried out. At the closing of the third chapter, recommendation will be given for a complex comparative ratio figure to determine the comparison for natural, organic cosmetics current market presence versus conventional ones.

Hypothesis

Nulhypothesis are being set in the different chapters of the article to determine whether the following statements are veridical or not concerning the context of the topics.

Hypothesis 1. is focusing on the question whether cosmetics supply chain has an impact on sustainability. Natural and organic cosmetics eco-friendlier and have only positive effects, comparing to conventional ones. The null (H_0) – and H_1 hypothesises were ascertained as follows:

H_0 = the statement is acceptable. Organic cosmetic products only have positive environmentally impact.

H_1 = not just positive effects according to some previous researches.

In Hypothesis 2. the increasing presence of sustainable environmental behaviour was observed. It was examinded if it is in alignment with environmental knowledge and requirements set by the frequently changing and strengthening regulation:

H_0 = the statement is true. There is a strong, evincible relationship between environmental behavior and environmental knowledge.

H_1 = there is not any detectable relationship existing between environmental behavior and environmental knowledge.

In Hypothesis 3. the authors investigated in the current scientific literature if the Standard regulation requirements for natural and organic cosmetic products are harmonized on a global level worldwide or not. According to this H_0 – and H_1 hypothesis were appointed:

H_0 = regulations are harmonasied globally.

H_1 = regulations differs territorial.

Hypothesis 4. tries to find out if there is an increasing need for laboratory measurements, to meet safety and health requirements in the field of cosmetics. Intensive growth in numbers of private laboratories providing external measurements can be experienced in the market:

H_0 = there is a strong connection to be detected between laboratory measurements and safety as well as health requirements in the cosmetic industry.

H_1 = there is no connection between laboratory research activities and safety requirements.

Results and discussion

Sustainable development in the view of cosmetics industry

The cosmetics industry represents an important economic sector with several thousand companies in Europe with over half a million employees and over five billion units of cosmetic products are sold in the European Union yearly with a total annual sales of 63 billion Euros (Cosmetics Europe, 2013). Although the total international market share is still higher for conventional, lower price cosmetic products with synthetic ingredients, Jones and Duerbeck (2004) established in their survey, an enhancing annual average growth of 8–25% estimated for natural products, in contrast for the lower increasement to be experienced on the synthetic products market, oscillating by 10–30%.

'Eco-friendly' cosmetic products

Blair (1992) defines the term 'eco-friendly' as concern in the production process, the life cycle and other factors, like the use of clean technologies, the rational use of natural resources, product certifications and biodegradable packaging, reducing non-renewable resources, using 'greener' processes, improving environmental performance. There is an ever increasing need to move towards more and more sustainable patterns of the production of

green, 'environmental-friendly', natural cosmetic products, which acquire holistic sustainability approach in Life Cycle Assessment (LCA) methodology by the cosmetics manufacturing companies (Secchi et al., 2017). According to Duran et al. (2014) the concept of innovation has an important influence on the competitiveness of cosmetics companies. Enhancing eco-innovation solution in cosmetics industry is leading to sustainable production with LCA methodology. LCA is the science underpinning the life cycle thinking. It is also a structured, internationally standardised concept for resources consumed, health and environmental impacts, covering the product's full life cycle process, from the extraction of raw materials, production, formulation, consumption and finally recycling up to the disposal of remaining waste. The entire cosmetics supply chain, from the initial sourcing of raw materials through to customer use and disposal has an impact on sustainability (Cosmetics Europe, 2012). Cosmetics manufacturing companies have been actively involved in supporting the sustainable consumption and production (SCP) of cosmetic products by developing and implementing a sustainability strategy in the last decades resulting contribution to the company footprint as well as following Good Sustainability Practise (GSP), which is crucial for long-term success (Cosmetics Europe, 2012). Secchi et al. reveal in their scientific article that there is an increasing interest in substituting fossil-based substances with renewable, bio-based ones. Fonseca-Santos (2015) pointed out in his paper that natural and organic cosmetics show quantitative differentiality, but have qualitative similarity into formulation. They contain raw materials derived from organic origin, and no synthetic or semi-synthetic raw materials are allowed in the formulation, with some exception. In bioeconomy there is an enhancing notion of substituting fossil-based substances with renewable, bio-based ones. According to Henderson et al., 2018 and a year later, in 2009, Kim et al. arrived to the same ascertainment concerning that there has been a growing body of literature about bio-process to be experienced, including the substirution of fossil based chemicals with renewable feedstock. In contrast to these statements, arguments have been arising in Jimenez-Gonzalez et al., 2011 work based on several research surveys, highlighting that from the perspective of LCA methods, using renewable feedstock or green chemistry is not always sufficient to ensure better environmental performance. The study points out that further complex evaluation is needed in comparison with the traditional, conventional synthetic routes and fossil based ingredients. In the publication of Secchi et al., 2016 demonstrate the different effects in cosmetic products through a case study (day cream) from the environmental protection point of view. The study reveals that several aspects must be taken into consideration for the final decision of green production.

Hypothesis 1. for 'Eco-friendly' cosmetic products, null hypothesis H_1 is being rejected taken the survey of Jimenez-Gonzalez et al. from 2011 as well as Secchi et al. case study in 2016. The statement of H_1, alternative hypothesis is acceptable. Green chemistry is not always sufficient to ensure better environmental performance.

Green consumer behavior

Society has become concerned about issues such as natural resources depletion or environmental degradation, becoming key consideration as cosmetics industry has a strong sence of social responsibility (Cosmetics Europe, 2012). Cosmetic products play essential role in every day life with enhancing efficacy by the growing expectation of the customers by setting up new challenges to R & D based laboratories in the field of applied researches.

The authors agree with the statement of Fonseca-Santos published in 2015 that green products, which regulated, improved and developed according to ecological standards and satisfy the customer expectation, are

safer for health and less toxic for the environment, increasing the lifetime of the products, developing reusable products or packaging, reducing the use of material and packaging, using recycled materials as well as reducing the use of natural products. According to Brower and Leon in 1999, followed by Adams, Jeanrenaud in 2008, and finally by Kates in 2010, sustainability is leading to a new directions for the development of raw material and products, environmental, people and waste management, improving the application of energy resources and consumer behavior (Fonseca-Santos et al., 2015). Fonseca revealed in his study in 2015, the importance of the increasing interest of natural products and biodiversity in the last decades by the growing presence of the consuming market, the green consumers' market. There is enhancing needs for natural as well as organic ingredients formulated, 'eco-friendly' cosmetics products among green customers.

Hailes's determinations in his publication of 2007, supported by the authors, stating that green consumer is concerned about the sustainable environment and regulation as well as follow their own preferences listed below when they buy organic and natural cosmetics:

- ❏ willing to pay higher price for an organic product;
- ❏ practical package design using a few materials;
- ❏ prefering products with biodegradable, recyclable or returnable packaging;
- ❏ preferring products without synthetic dye;
- ❏ refusing products containing raw material derived from endagered flora;
- ❏ refusing consuming products derived from animals;
- ❏ not accepting products tested on animals;
- ❏ searching for organic products;
- ❏ social and environmental responsibility;
- ❏ being aware of the culture and behavior of the cosmetics companies.

Tanner (2003) reveals in her study that there have been several previous psychological environmental researches focused on the role of factors for individuals, such as knowledge, environmental concern, attitudes, norms and values (e.g., Hines, Hungerford and Tomera, 1986; Maloney and Ward, 1973; Van Liere C Dunlap, 1981) Results of researches have proved to be relation between consumer behavior and consumer attitudes and motives. In Tanner's (2003) publication customer relevant impact on environmental behavior classified into four categories:

1. Measures of Specific Attitudes: a consumer survey by Mainieri et al. (1997) reveal that consumer beliefs predict environmental- friendly consumer behavior more accurately than general environmental concern.
2. Percieved Barriers: several studies have posited that notions of perceived behavioral barriers are preditors of environmental behavior (e.g., Axelrod and Lehman, 1993; Grob, 1995; Hines et al., 1986).
3. Knowledge: environmental knowledge has been positively related to environmental behavior.
4. Personal Norm: number of researches performed that personal norm is powerful motivitor of environmental behavior (e.g., Hopper and Nielson, 1991; Stern and Dietz, 1994; Stern, Dietz and Black, 1986; Vining and Ebreo, 1992) These investigations suggest that environmentally fiendly behavior may be characterized as morally demanding.

Null hypothesis is being approved at Hypothesis 2. at Green consumer behavior at Chapter 3.3, by several scientific publications (Hailes, 2007; Tanner, 2003; Hines, Hungerford and Tomera, 1986; Maloney and Ward, 1973; Van Liere C Dunlap) supported by surveys carried out by researchers.

Demonstrating that there is a strong, evincible relationship between environmental behavior and environmental knowledge.

Regulation, legislation compliance

Cosmetic products are under high regulation and ensure full compliance with requirements of the chemical and cosmetics legislation. The United States (US) and European Union (EU) both work to ensure the safety of cosmetics for consumers through rigorous regulation. In the US, the cosmetics industry is regulated by the US Food and Drug Administration (FDA) granting regulatory authority under the federal Food, Drug and Cosmetic Act, enacted in 1938. The 27 European Union Member States have transposed the European Union Cosmetics Directive, enacted in1976, into national law. (Cosmetics Info) Recently, European cosmetics manufacturers must comply with the legal requirements of relevant legislation of Directive 76/768/EC and the new Regulation 1223/2009. Cosmetic products have several strict mandatory requirements towards human and environmental safety. According to Duran et al. (2014) the aim of the regulation requirements is creating a free European market for cosmetic products, which guarantee the health and safety of the consumers through the establishment of a number of technical limitations on cosmetic composition. Products are to be categorized by natural and organic, which standards are set by regulatory and certification agencies worldwide without being harmonised on global level. In accordance with the European Cosmetics Organic Standard (COSMO), organic cosmetics must have at least 95% of organic ingredients produced and 20% of the total product must be organic. The percentage of origin requirement criteria for cosmetics organic and natural products differ territorially worldwide. There is no European harmonised standard which sets criteria for natural and organic cosmetics. (Legislation, European Commission)

Substances of cosmetic products in Europe, are subjected to the application of the REACH (Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals) regulation (EC, 2006). Secchi et al. (2017) highlight in their work that the Regulation implies for each substance to be conducted in a cosmetic formulation, environmental and human risk assessment. In Munoz et al. study in 2008 the fact of the evidence of potentail environmental impact on water toxicity caused by cosmetics and personal cares is stated followed by the introduction for the needs of ecodesign and green strategies for production. In Hungary, laboratories, concerning analytical measurements for eco-safe cosmetic products and packaging, must comply with the requirement of 40/2001 (XI. 23.) EüM regulation (www.synlab.hu).

For Hypothesis 3. at Regulation, legislation compliance in Chapter 3.4. the alternative hypothesis, H_1 is veridical. Cosmetic regulation is not being harmonised and differ territorial.

Methodology in the laboratory field

The essential role of laboratory field in the support of cosmetics industry

Cosmetic products and their substances, ingredients must be safe and meet the current regulation requirements. Cosmetics laboratories have high responsibilities for substance compliance in analytical method process for sustainable cosmetic products as well as the evaluation of the environmental impact might caused by the raw material used in the production. Secchi et al. (2016) review in their study that R & D acitivites in the field of cosmetics, food and pharmaceutical ingredients have been focusing on sustainable environmental development of the final products. The survey reveals that infact, cosmetics and pharmaceutical ingredients production have significantly more environmental impacts than basic chemical production in a kilogram-per-kilogram basis.

Analytical laboratory instruments and measurements in cosmetic products

Multinational cosmetics companies have their own research laboratories, smaller cosmetic companies from the small and medium-sized enterprises sector (SME) either having smaller laboratories, not so well equipped, with some basic, general laboratory devices, or outsourcing their analytical measurements to contract laboratories. Several private research laboraties (In Hungary: Balint Analitika, Wessling Hungary part of the Wessling-Group, Synlab laboratories for environmental protection) are responsible for carrying out external contractual measurements or executing research activities having less negative environmental impact, less damage to the environment, revealed by the authors through deep interviews carried out by laboratory managers.

Laboratory measurements can be classified according to the type of examination:

❏ chemical measurements;

❏ microbiology measurements;

❏ stability measurements;

❏ allergen measurements.

Concerning the cosmetics industry, Loren et al. (2016) reviewed that chemical substances must meet the regulatory criteria to be legally used as ingredients in cosmetics and personal care products. Laboratories need to evalute the degree of compliance for each substance measurements through adequate analytical methodology. The Loren et al., 2016, article deals with the most recent analytical methods used for cosmetic products production procedure, from the extraction through the determination of ingredients, especially the ones in the positive lists of the European Regulation of Cosmetic Products (EC 1223/2009) compromising the main ingredients in cometics, such as colorants, preservatives and UV filters. As cosmetics are complex samples, most of them need sample pretreatment before analysis. (Loren et al., 2016) Analytical methods for cosmetic products consist of sample preparation with different techniques, followed by determination of all ingredients.

In order to determine of micro molecule size and analysis of the stability, viscosity as well as consistency of the different types of cosmetics materials further important particle sizing and characterization laboratory instruments are needed, which are detailed in Table 1.

Table 1. show the importance as well as the wide range of variance of equipment in research laboratory for an efficient analytical methodology, quality control and the support of sustainability in the cosmetics industry.

Hypothesis 4. clearly determines the acceptance of the null hypothesis in Chapter 3.5.1. and 3.5.2., due to safety and health requirements, the number of laboratories as well as the needs of natural and organic cosmetic products are intensively growing. The trend seems to be consequent.

Comparative ratio figures for the cosmetic industry

Determining the distribution ratio for the recent cosmetics market size for natural, organic versus conventional products and the number of analytical laboratory equipments for natural cosmetics measurements as well as R & D activities the following comparative figures are proposed:

$$C(s) = \frac{synthetic\ cosmetic\ products}{total\ cosmetic\ products} \times 100\ (\%)$$

$$C(n) = \frac{green\ cosmetic\ products}{total\ cosmetic\ products} \times 100\ (\%)$$

where:

$C(s)$ and $C(n)$ ratios – define the market presence in percentage compared to conventional and natural, organic cosmetic products.

$$C(lab) = \frac{laboratory\ equipments\ for\ natural\ cosmetics\ measurements}{total\ laboratory\ eqipments} \times 100\ (\%)$$

$$C(research) = \frac{RD\ in\ cosmetics\ field}{total\ RD} \times 100\ (\%)$$

where:

$C(lab)$ and $C(research)$ ratios – determine the growing importance of research activities in the cosmetic industry by the increasing number of laboratories, supporting the production of natural and organic cosmetics.

According to the authors' opinion the above introduced equations could be appropriate for deeper investigation on the constitutions of the cosmetic market. Data collecting is needed for firther examination.

Conclusions

In the last decade market share of green, 'eco-friendly' cosmetics has been growing in large steps worldwide. According to literature the annual average growth of environmental friendly cosmetics is significantly higher than conventional ones; suggested comparative ratios can be implemented to measure current market shares. Therefore sustainable cosmetics market deserves to get prime attention. Sustainability is a relevant topic in all fields from the perspective of economic, environmental and social impact. Regarding cosmetic products developed by the cosmetics industry, environmental pillar has to be taken into consideration as the most striking factor. Cosmetics manufacturing companies, certification agencies and scientific research laboratories have to meet the requirements of the latest regulation and standards locally without any intention for global harmonisation yet. Analytical laboratories play key role in regard of new research technology for analytical methods in the production procedure for cosmetic products. Yet, several studies show that each new research of used natural substances as ingredients in cosmetics towards sustainable products

Table 1 Methods analysis of particle sizing and characterization

Particle size analyser methods	Emulsion	Suspension	Powder
Dynamic Light Scatter (DLS)	■ measure products to ensure the performance and stability	■ measure water-based dispersion samples	■ particle size testing and particle shape analysis Improve the efficacy Monitor and conrol product quality
Laser Diffraction (LD)	■ control quality to ensure compliance with regulatory standards	■ oily solvents and toxic solvent dispersion samples ■ measure all kinds of suspension agents ■ quality performance	
Electrophoretic Light Scattering (ELS)	■ Zeta potential (stability analysis)	■ Zeta potential (stability analysis)	-

Source: Own structured by the annual scientific training of 3P Instruments on laboratory instruments, Odelzhausen, Germany, September 2018

must be invidually evaluated from all aspects of any environmental, social and economic impacts. More complex laboratory researches must developed in future to assist sustainable innovation. The emerging number of natural ingredients and product safety cause an increasing need to recruit new and more and more sophisticated laboratory equipments as well as develop new analytical methods.

Following careful consideration and examination of the set hypothesis the results provide a clear reflection on the today's cosmetic market trends concerning the intensive growth of natural and organic cosmetic products. The results of the set hypothesis show an idication towards problematic field of the cosmetic market to be solved, such as carrying out complex survey on green chemistry production in aspects of sustainable environment; furthermore ensure standard regulation harmonisation worldwide to ensure that consumers receive the same, standard level of cosmetic products' quality overall on a global level.

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https://www.cosmeticsinfo.org/Regulation-in-eu-us

www.ec.europa.eu/info/law_en, Legislation, European Commission

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