

## FUNGI IN FASHION

DALJIT SINGH ARORA<sup>1</sup> & HIMADRI<sup>2</sup>

<sup>1</sup>Professor, Microbial Technology Laboratory, Department of Microbiology, Guru Nanak Dev University, Amritsar, India

<sup>2</sup>Microbial Technology Laboratory, Department of Microbiology, Guru Nanak Dev University, Amritsar, India

### ABSTRACT

*Fungi and fashion sound far away from each other and are not related in anyway. But if we look closely from the prospective of a biotechnologist, fungi have got a bearing on fashion and have played a major role in revolutionizing the modern fashion industry. Fashion is portrayed in the English lexicon as the overall expression of one's personality which changes with changing times. But how the fungi generally perceived as dreadful agents of disease, can play an important role in fashion industry. Thus the present paper has been designed to reveal the cryptic role of fungi from a different perspective in the present era of fashion and glamour. Statins, the important cholesterol lowering compounds and other nutraceuticals used in sliming industry again come from fungi. Once, we achieve the desired physique and health, to cover this well groomed physique and curvaceous body, here come the role of fungal biotechnology used for refined and modern clothing, be it bio stone denims, bio pigments in textile dyeing and fungal enzyme based detergents in fashion industry. Thus objective of the present review is to connect the biotechnological role of fungi in diverse areas of life style with fundamentally targeting the fashion.*

**KEYWORDS:** Fashion, Fungus, Biotechnology, Health, Modern Society

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### INTRODUCTION

Fashion is the predominant mode of expression. Fashion senses the changes occurring in the society and respond to them delicately and promptly. These progressions can be directly seen in the way the people dress, giving unambiguous information about the wearers, their riches, taste, age, national qualities, and so on. Fashion has allowed wearer to express emotions or solidarity with different people for quite a long time. Our sense of style communicates our personality as well as our identity. The achievements of the fashion trend lies in the way the society or general public accepts and interpret it.

Fashion and fungi are two words which sound far from each other. As fashion is the word for charm, magnificence and excitement, fungi to an ordinary man are something feared or dreaded. In any case, if we look at it differently and carefully from the biotechnologist perspective, fungi have an important impact on fashion and have assumed a noteworthy part in reforming the fashion business. Fashion expresses a process or a fact that associate with so many areas, a variety of regions, either directly or in a more generalized way. Looking at fashion history, the fashion concept was primarily considered as the way to clothing and its type, but now it is much more than just clothing. Today it has widened its scope considering almost all the vital and crucial elements. Fashion and clothing are the areas which individuals use to express themselves clearly and confidently and it also reflect the changes in their mindset and personality with changing times. Various fungal enzymes have now become an integral part of textile processing. Faded denim is the most pervasive garment worn everywhere

throughout the world by rich and poor, youth and old, alike. This faded look can be obtained with the help of fungal enzymes which act on the cotton yarn and facilitate the removal of indigo dye from its surface (Lars et al. 1991). Eco-friendly textile which is without harmful chemicals & dyes and instead is extremely comfortable and gives a delicate touch to body goes under green fashion (Jain et al. 2004). Bio-based garments and natural dyes from fungi have assumed a noteworthy part in revolutionizing the fashion industry. Cosmetics and personal care products have become an additional integral of the fashion world and tries to keep pace with fashion trends by introducing or presenting new colours and products occasionally. Fruiting bodies of some wild and cultivable mushrooms contain medicinal compounds which are being utilized as a part of the traditional medicines and cosmetics (Firenzuoli et al. 2008). This paper provides a review of the fungi presently utilized as a part of cosmeceuticals and nutricosmetics with some examples of cosmetic products. Different pharmaceutical compounds or wonder drugs of today originate from fungi. Fungi give strikingly capable pharmaceuticals that have got the potential to human health and have massive economic worth (e.g. antibiotics, immunosuppressants, and cholesterol lowering medicine). The penicillin, cephalosporin, cyclosporine, and statin like drugs, all in the lime light, are characteristic chemicals derived from fungi.

Several species of macro fungi are considered luxuries and are developed or cultivated for the human food. Fungi have demonstrated their universality even in our daily routine, for instance drinks (sizzling wine, cool beer and soothing brandy) served in the luxury parties; discover their birthplace in alcoholic fermentation completed by fungi. The use of word organic spread in all domain of the society, being it organic farming, organic food, organic clothes and so on. In agriculture, organic fashion emphasizes the use of renewable resources to preserve soil and water quality to upgrade environment quality for future generation. Mycorrhizal fungi are widespread in agricultural frameworks and are particularly significant for organic agribusiness, since they can act as natural fertilizers, upgrading plant yield (Smith et al. 1997). Fungi play major role in both, coffee plantation ecology and help in its decaffeination, which is also the requirement of modern society. As discussed in the proceeding paragraphs, fashion cannot be considered an isolated entity, it has to be looked in totality or in its wholesomeness, which is imparted to one's personality, and even with a idea in mind as biotechnologist that link various aspects of fashion with fungi.

## FUNGI IN TEXTILE

When we consider clothing, we simply think of it as something which give coverage to our body, convey our sense of style, and shield us from the environmental components. But the future of clothing is changing fast because of self awareness and fashion quotient, and smart textiles are responsible for this change. Smart textiles are fabrics that provide added value to the fabric and enhanced utility to the wearer, thus enhancing the smartness by using new technologies. There are fabrics that help regulate the body temperature therefore give added qualities to the wearer. Various health and beauty industries are additionally taking advantages of these innovations, which range from medication discharging textile material, to fabric with moisturizer which provides waxy covering to the body and hostile to anti-aging properties (<http://www.forbes.com>).

Many bioactive molecules produced by fungi are important in the paper pulp industry, for bioremediation, and even for fashion: fungal enzymes such as cellulase are utilized to fade and soften denim jeans. Stone –washed denim used to mean, literally washing with small pumice stones to distress the fabric. Now fungal enzymes from *Trichoderma reesii* randomly break cotton fibres and give the similar fashionable bleached look. The gene for the cellulase enzyme was initially isolated from the fungus *Trichoderma reesii* and after that put into bacteria for large scale production.

Cellulases attacks the uncovered cellulose on the outside of the every cotton fiber and break a portion of the molecular bonds, so that exclusive the dye particles are loosen from the surface without changing the interior of the cotton, fibers thus in this way bringing about faded colour (<http://www.denimhelp.com/>).

The similar fungal enzymes are also used as “fabric conditioner” to remove broken fibre ends and make the fabric look and feel like new. This additional dimension helps fashion designers to create a wider range of shades in clothing.

Biological washing powders to remove soiling also depend upon fungal enzymes. Fungi are one of the most vital sources for lipase of industrial applications. The main producers of industrial lipases are *Aspergillus niger*, *Candida cylindracea*, *Humicola lanuginosa*, *Mucor miehei*, *Rhizopus arrhizus*, *Rhizopus. delemar*, *Rhizopus. japonicus*, *Rhizopus. niveus* and *Rhizopus. oryzae* (Elibol et al. 2002; Mahadik et al. 2002; Maia et al. 2001). Due to low cost of production, thermal and pH stability, substrate specificity fungal lipases are being exploited commercially (Lawson et al. 1994). There is a wide range of brands of laundry detergents, and generally they claim some extraordinary qualities (Bajpai, 2007). SEBrite-L detergent containing lipase helps in removing cosmetics, sebum and greasy food stains from clothings, appropriate to use at neutral pH and lower washing temperatures. Various lipase containing laundry detergents such as Tide, Ivory Snow, Dreft, Cheer, and Era are marketed by Procter and Gamble (P&G). P&G searches for microbial genes which can satisfy consumer needs, e.g. an alkaline cold wash enzyme by a set number of cycles of directed evolution, is a major challenge in using mutagenically improved strains of microorganisms. A huge number of mutants must be screened to locate the best strain (<http://www.scienceinthebox.com/>). For elegant and smooth finish, synthetic fabric is additionally subjected to protease treatment. Fungal proteases are the key bioactive compounds in fabric industry since decades and further growing tremendously. The different alkaline proteases producing fungal species are *Aspergillus flavus*, *A.fumigatus*, *A.melleus* and *Penicillium griseofulvum* (Ellaiah et al. 2002).

Dyeing is one of the most delightful textile art which is an important branch in fashion design. Synthetic dyes are used globally in textile industries because of their accessibility, lower cost and wider range of bright shades in contrast to natural dyes (Nagar et al. 2005). But due to heavy load of chemicals in synthetic dyes, much effluent produced during textile dyeing would pollute the environment. In this way, it has generated the interest of fashion industry in natural dyes which have gained momentum because of increased awareness of the ecological and health risks connected with synthetic dyes (Iqbal et al. 2007). Natural dyes are non toxic, non pollutant and antimicrobial in nature. Natural dyes can be obtained from different sources like plants, animals and microbes. Microbial dyes are generally more preferred over animal and plant based dyes because microbes are fast growing and have the industrial potential. Fungi contain several secondary metabolites such as anthraquinone compounds which play very unique role in textile industry. Other applications of fungi also include their use to extract pigments for watercolours, and to obtain a high quality chitin-based paper (Rice et al. 2012).

The fungal garment produced from mycelium is also a novel concept. Wedding dresses produced using a combination of tree mulch and a naturally white fungus as shown in Figure 1 opens up a new zone for fashion industry. The concept behind a field grown wedding dress was to take a one-time-use object at a low cost. This fashion chain not only brings us closer to the nature as well as reflects our unnecessary consumption habits. The smashed fruiting body of *Fomes fomentarius* are used for making fashionable hat (<https://itp.nyu.edu/>). Numerous fashion designers, for example, Issey Miyake, Hussein Chalayan and Walter Van Beirendonck, are helping in transforming today’s science fiction into tomorrow’s existence.

Donna Franklin is another genuine example of a collaborative practitioner that has turned organic matter to look for new solutions by making a 'living garment' made from the orange bracket fungus as shown in Figure 2 at her artistic laboratory- Symbiotic A (Lee 2005).

## FUNGI IN COSMETICS

The cosmetics are the valuable products used extensively throughout the world for maintaining and improving general appearances of face and other parts of the body. It includes face powder, nail polish, face packs, creams, lotions, hair oils, conditioners etc. Smooth, shiny, healthy skin and hair certainly count for beautiful women and handsome men. Cosmetics alone are not sufficient to take care of skin therefore requires association of the active ingredients to check the damage and ageing of skin. Herbal cosmetics have now emerged as appropriate solution to the current problem. Herbal cosmetics represent cosmetics associated with active bio-ingredients and nutraceuticals. The beauty of the skin basically depends upon individual's diet, habits, job and climatic conditions. In Asian culture "Whiteness" or having fair skin is viewed as pride possession for female beauty and acquiring fairer complexion is a mad race among females. In summer extreme sun exposure increases melanin content and dries out the skin. Melanin is the major pigment basically secreted by melanocyte cells in the basal layer of skin (Hearing 2005).

Tyrosinase enzyme is a copper-containing monooxygenase that increases melanin synthesis in melanocytes of the skin (Sturm et al. 2001). Melanin biosynthesis can be inhibited by less exposure of UV, inhibition of tyrosinase, or by expulsion of melanin by corneal removal Seiberg et al. 2000). Tyrosinase inhibitors are effective components of different skin lightening beauty care products. Several mushrooms extracts have been shown to possess tyrosinase inhibitory activity. As compared to other basidiomycetes, *Ganoderma lucidum* possess significant inhibition of tyrosinase activity with IC50 value 0.32 mg/ml. Due to tyrosinase inhibitory activity, mushroom extracts contributed to better healing properties in different Chinese traditional herbal beauty care products (Chien et al. 2008).

In addition, various extracts from mushroom are also thought to have skin whitening properties. Today many well known brands e.g. Origin's Plantidote Mega-Mushroom Treatment Figure 3, Actifirm Actizyme Renovation Mushroom, Alqvinia Eternal Youth Cream Figure 4 and Menard Embellir line add mushroom extracts to their products (Hyde et al., 2010). This idea basically exploits the concept that fungi can bleach wood and degrade melanin (Mohorcic et al. 2007). Among the wild fungal isolates for melanolytic action, *Sporotrichum pruinosum* is the most promising fungi that decolourise synthetic melanin.

Both gallic and ellagic acid can be produced from plant tannins via fermentation using *Aspergillus niger* oxidants (Ventura et al. 2008), suggested for use in brightening the skin and in addition having anticancer properties (Fang et al. 2008).

Various organic pigments such as carotenoids found in some fungi, are widely used in skin care products particularly in sun lotions e.g. Methode Jeanne Piaubert -Anti -Ageing Facial Sun, Kiehl's Since 1851 Multi-Purpose Facial Formula (Jin et al. 2010). There are number of micro-organisms, including species of *Monascus*, *Paecilomyces*, *Serratia*, *Cordyceps*, *Streptomyces*, *Penicillium herquei* and *Penicillium atrovenerum* have the ability to produce yellow and blue pigments in high yields. Amongst them, many fungal species have got an enormous consideration, for example *Penicillium*, produced anthraquinone, a red pigment which can be used in cosmetic products like nail polish, lipsticks and showing high chemical stability (Hajjaj et al. 2000).

Lycopene a potent anti-oxidant found in tomatoes has additionally been found in wild mushrooms (Barros et al. 2007) and now has also been reported in *Blakeslea trispora* (Mantzouridou and Tsimidou 2008). Presently tomato lycopene is utilized as a part of cosmetics (e.g. Tomato Lycopene Face Cream).

Most of the microbial pigments productions are still at the R&D phase. There are many studies in the literature on various microbial pigments which focus on production and application of specified pigment in each case. Hair colouring is one of the major trends in society, which represents the fashion. Various bio based hair colours are available in the market like vegetal bio hair colour, made of vegetable extracts. As we know, fungi are also the source of natural pigments; an attempt can be made to connect the biotechnological role of fungi in this area of hair colouring fashion.

Chitin-glucan is a copolymer present in the cell wall of various fungi such as *Aspergillus niger* (Gautier et al. 2008). Though, chitin glucan has good moisturizing properties and can help fight against free radicals responsible for skin aging therefore can be used in skin moisturizing and anti-aging formulations. Several mushrooms are recognized to have medicinal properties especially in the production of  $\beta$ -glucans (Kalac 2009).  $\beta$ -glucans are a group of bio-active polysaccharides with a proven pleiotropic immuno modulation effect. Topical application of  $\beta$ -glucans in dermatology is expanding, since their pluripotent effects such as anti-oxidant, anti-inflammatory, immunomodulation, UV protection and moisturization, could help in the treatment of various skin diseases (Castelli et al. 1998). A traditional Chinese medicine *Tremella fuciformis*, is used as a skin care product by women in China and Japan. Because it reportedly helps in moisture retention in the skin, avoid senile degradation of micro-blood vessels in the skin, reducing face wrinkles and smoothing fine lines (Reshetnikov et al. 2000).

## FUNGI IN MEDICINES

In 21<sup>st</sup> century the field of health care and medicine struggled with various problems such as infectious disease threats, various epidemics, obesity and various similar communicable diseases. As a common proverb 'healthy mind in a healthy body' we obviously know that we should be both physically and mentally healthy. But most of us seem to be ignoring this simple mantra in today's times. The general "antifat" attitude is particularly pronounced in girls, who show stronger desire to be thinner. Barbie is the top of the fashion style doll in each major worldwide business sector, with overall annual sales of about \$1.5 billion (Mattel 2003). Barbie's body proportions, is the cultural icon of female beauty that gives an optimistic good example for young girls. Cardiovascular diseases are one of the most well known reasons for mortality in the Western world. If we have too much cholesterol in our body, it sticks to the inside walls of our blood vessels, and reduces the diameter thus restricting the blood flow. To control cardiovascular diseases it's important that people should regulate their cholesterol level. Statins, which are produced by fungi, turned into the focus of great attention, because of their capacity to impact the *de novo* synthesis of endogenous cholesterol (Nidhiya et al. 2012). Statins blocks the key enzyme 3-hydroxy 3-methylglutaryl Coenzyme-A reductase (HMG Co-A reductase) needed to make cholesterol by using the mechanism competitive inhibition (<http://www.medscape.org>), so synthesis of cholesterol in the reaction is slowed down (Nigam et al. 2014). Of many statin molecules, lovastatin and mevastatin are natural and are produced as secondary metabolite by a variety of filamentous fungi. While different statins like rosuvastatin, simvastatin, pravastatin, fluvastatin, atrovastatin, cerivastatin, are derived semi-synthetically from natural secondary metabolite lovastatin (Jonathan et al. 2003). Today, numerous individuals rely on statins produced from fungal sources to keep their cholesterol level normal. *Aspergillus terreus* has been investigated extensively for the commercial production of lovastatin by batch fermentation (Manzoni et al. 2002). It can also be synthesized from various fungal strains like *Penicillium sp.*

(Endo et al. 1985), *Monascus ruber* (Juzlova et al. 1996), *Monascus purpureus*, *Acremonium chrysogenum*, *Trichoderma viridae*, *Pleurotus sp.* etc.

Organ transplant, characterized as the exchange of a living tissue or organ to an injured or sick person to re-establish wellbeing or reduce disability, initially began in the 1930s. Face has got far greater role to play in the development of one's personality. In the glamour world such as film industry, face has its own worth beyond one's expectation. Eyebrows, moustaches, facial hair contribute to a bigger degree to make the face more lovely and appealing. The facial hair transplant for such hair growth is a minimally invasive procedure. Organs transplantations are very widely exploited in the modern societies through a very much controlled and precisely checked framework that can deliver them from donor to patient. It's all thanks to a new generation of immunosuppressive drugs that made organ transplants possible on wide scale. Cyclosporin is another crucial pharmaceutical compound of today. Cyclosporine A is a potent immunosuppressant that has significantly contributed to the long term transplant of kidney, heart, liver, lungs and other organs in the human body (Bhosale et al. 2011). This compound is mainly produced by fungus *Tolypocladium inflatum*, *Fusarium solani* and *Neocosmospora vasinfecta* (Aarino & Agathos 1989; Sawai et al. 1981; Nakajima et al. 1988). Cyclosporin A is a cyclic 11-membered fungal peptide metabolite (Abdel et al. 2007) which act mainly on T-lymphocytes, if lymphocytes are not able to increase in number then the transplant will not be detected as foreign organ (Borel et al. 1976; 1977). In today world cyclosporine is one of the most effectively used immunosuppressive medication, which reversibly inhibits only some classes of lymphocytes and does not influence haemopoietic tissues, for example, bone marrow.

We still rely on penicillin, since it contributed significantly in a major way to a revolutionary change in therapeutic treatment, which changed the human way of life to such a degree, to the point that infections which were normal reasons for death and disabilities are presently rarely encountered. Various pharmacologically active substances are presently derived from wood-rotting fungi of the phylum Basidiomycota (basidiomycetes) and Ascomycota.

There are about 500 members of the Aphyllphorales which have shown strong antimicrobial activities and constitute a practical hotspot for the advancement of novel anti-microbials (Zjawiony et al. 2004). The term, 'mushroom nutraceuticals' is used for a new class of compounds extracted from various mushrooms and have both nutritional and medicinal properties. Mushrooms contain functional "nutraceuticals" which have different degrees of immunomodulatory, lipid-lowering, antitumor, and other useful or remedial wellbeing activities with no noteworthy poisonous quality (Wiley 1991). The medicinal use of mushrooms (higher fungi) has a very long tradition in the Asian countries, whereas in the Western hemisphere their use as most important medicinal tool has been slightly increasing only since the last decades. Fungi can bring about a variety of chemical transformations of compounds, especially steroids, in a reliable and reproducible way. Most of the steroids in clinical use today are modified. The highly specific fungal enzymes make a chemical change that otherwise require twenty or thirty steps for their production in pure chemistry. Using fungi in this way is a convenient and economic means of making specific compounds which would be otherwise very difficult, impossible, or just too expensive to produce by purely chemical synthesis. We might hope that some of the oriental remedies might yield to modern western analytical techniques so that the active principles of centuries-old medicines can be identified, purified and turned into 'western-style' drugs.

## FUNGI IN FOOD

We all consume or come in contact with fungal products daily in our routine. Except mushrooms, yeasts are single celled fungi without which we would have been deprived of and our daily life would have been relatively duller. Fungal products are used to manufacture, ripen and flavour cheese, squash and fizzy beverages which contain an acidity regulator derived from fungi (<http://www.ukfungusday.co.uk/>). Indeed, even in chocolates, fungi play a crucial role in enhancing flavour, and the list goes on. Fungi make a nutritious food with twice the protein of most fresh vegetables, fibre, minerals, essential fatty acids and vitamins including B<sub>2</sub>, B<sub>12</sub> and niacin. In modern world, fungi are continuously exploited in food because of few calories and little fat, and best of all, no cholesterol. These advantages are equally provided by yeast cells and mushroom. But with huge range of textures and taste, mushrooms can be an adventure tool for a cook as shown in Figure 5 ([www.honest-food.net](http://www.honest-food.net)).

In modern societies people would prefer a non-alcoholic beverage with their lunch; perhaps a can of cola. When we look at the ingredients list on these beverages, a typical product is citric acid which is generally utilized as stabilizer as part of drugs and acid regulator in food and beverages. Today about 600000 tons of citric acid per year is produced by fermentation using *Aspergillus niger*.

True luxury means different things to different people. It may include watches and jewellery (hard luxury) or fashion and clothing (soft luxury). These attributes apply not only to the two traditional categories of luxury—hard luxury (such as watches and jewellery) and soft luxury (such as fashion and clothing). In the eyes of most consumers, luxury also extends to alcohol and food. A nice glass of wine, cool beer and comforting brandy; every drop of alcoholic beverage production depends upon the yeast fungus. In our modern world, brewing is a fine art and important part of daily life, often carried out by women and is one of the few professions adopted by them. In a fermentative process, sugars are broken down by yeast (e.g. *Saccharomyces cerevisiae*) into alcohol and carbon dioxide. However, due to sensitivity of fungi to high alcohol concentration, only 15% sugar is converted to alcohol as compared to 50% expected conversion under ideal conditions. In beer production, cereal grains are used as ideal substrate for fermentation, whereas wine and hard cider fermentation involves grapes and apples as substrates respectively. The utilization of yeast (e.g. *Saccharomyces cerevisiae*) to make alcohol and CO<sub>2</sub> uses the fermentation process to break down sugars. Up to half of the sugar can be converted to alcohol, but only 15% can be converted in light of the fact that the fungi are sensitive to high concentrations of alcohol. In the beer making industry, cereal grains are fermented to make the alcohol. Wine is mainly produced using fermented grapes as substrate whereas in hard cider fermented apples are the raw products. Sake is produced by treatment of rice using *Aspergillus oryzae* and then an additional fermentation step carried out by bacteria and yeasts (Alexopoulos et al. 1996)

A little cheese also goes well with a drink. In cheese production originally milk was curdled with rennet, extracted from calves' stomachs, but today 90% cheese is made using chymosin from the mould fungus *Aspergillus niger*, or a fungal 'rennet' enzyme obtained from *Rhizomucor miehei*. A little bread also goes well with cheese. Every slice or roll of bread depends upon the fermentation by yeast. In bread making, due to fermentation carbon dioxide produces the bubbles and causes dough to rise, while the alcohol produced evaporates off during baking. A variety of foods and drinks consumed undergo the fermentation process. The people of Asia have developed a wide variety of fermented foods include bean cheese (*Rhizopus*), Chinese cheese (*Rhizopus*), koji (*Aspergillus*), miso (*Aspergillus*), shoyu (*Aspergillus*, *Saccharomyces*) and tempeh (*Rhizopus*).

To meet the protein need of our body microorganisms have been used for many years in the production of high protein food. In the industry, microorganisms have the ability to upgrade low protein organic material to high protein food. Single cell protein refers to the protein obtained from pure and mixed culture of algae, yeast, fungi and bacteria” (Vincent. 1969; Becker & Venktaraman 1982). Filamentous fungi that have been employed for the production of single cell protein which include *Chaetomium cellulolyticum*, *Fusarium graminearum*, *Aspergillus fumigatus*, *A. niger*, *A. oryzae*, *Trichoderma viridae*, and *Trichoderma alba*. Yeasts such as *Candida utilis* (Torula yeast), *Candida lipolytica*, *Candida tropicalis*, *Candida novellas*, *Candida intermedia* and *Saccharomyces cerevisiae* are all among the various organisms that have been used for the production of SCP (Bhalla et al. 2007).

## FUNGI IN AGRICULTURE

Agriculture is characterized as the science, routine of cultivating and enhancing the crops yield, raising livestock and marketing of the resulting bioproducts. Almost all medicine, publishing, education and recreation have some component that originates with agriculture. The main purpose of agriculture is to produce the food we eat. In addition to food, agriculture gives fiber, housing. In fact, agriculture connects to our life every single day, in each and every way. Modern society is significantly more materialistic than it was fifty years ago. We are constantly bombarded by the media and advertisers with images of the so called perfect life- slim beautiful people in fashionable garments, driving top of the range cars and living in big houses full of material goods like wide screen TVs and the more recent PCs. Due to increased awareness and health conscious society, everything we buy in today’s world involves a well informed decision regular, low salt, low fat or low sugar? Perfumed, unperfumed or hypoallergenic? Caffeinated or decaffeinated, Organic or non organic? Fresh frozen or tinned? The proverb ‘organic fashion’ is in vogue for present day society. Garments and adornments viewed as natural or organic when they are made using fibres without the utilization of chemicals for example conventional pesticide, without synthetic fertilizers, without bioengineering or ionizing radiations.

Organic fashion emphasizes the use of renewable resources to conserve soil and water quality to upgrade environment quality for future generations. Mycorrhizal fungi are widespread in agricultural systems and are particularly significant for natural agribusiness since they can go about as natural fertilisers which can enhance plant yield. Arbuscular mycorrhiza fungi form broad hyphal networks in soil and give nutrients to the plants (Smith et al. 1997). Arbuscular mycorrhiza fungi can act as support systems for seedling foundation; provide resistance against drought, pathogens, and can upgrade biological diversity in grassland (Heijden et al. 1998). Additionally, fungi not only show direct effects, but there are also a number of indirect effects such as improvement of soil quality and the concealment of living beings that decrease crop productivity and effectiveness.

As evident from above ongoing discussion, the modern society is more inclined towards decaffeinated coffee. Fungi play a major role in both, coffee plantation ecology and decaffeinated coffee. The essential role of fungi in coffee plantations is to degrade the vast amounts of complex organic molecules created occasionally because of the addition of plant residues, organic fertilizers, leaf litter, and change over them into less complex compounds important for plant development and advancement. Demethylation of caffeine in position 7 resulting in 1, 3-dimethylxanthine which is the major degradation product of caffeine by various filamentous fungi grown in liquid medium as in Figure 6 (Hakil et al. 1998). Theophylline may even available at the end of fermentation when caffeine has been completely evacuated.

Caffeine degradation has been observed by fungal species like *Stemphyllium*, *Penicillium* and *Aspergillus*. Appreciable growth showed by *A. tamari*, *A. niger*, *A. fumigatus* and *P. commune*, when caffeine was used as the sole

source of nitrogen. *A. tamari* and *P. commune* reveal great caffeine degrading capability (about 60%) whereas others caused less than 20% caffeine degradation. Bioremediation of coffee pulp to lessen the caffeine content has been concentrated more in fungal frameworks. Among the microbial community present in the coffee pulp, just a couple of species like *Aspergillus*, *Penicillium* and *Rhizopus* could degrade caffeine. *Aspergillus* and *Penicillium* species degraded caffeine nearly with 100% efficiency at 25°C (Roussos et al. 1995). From the ongoing discussion it becomes clear that how the fungi have impacted the agricultural practices in more than one way thus impacting the fashion and connect to our life in each and every way.

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## CONCLUSIONS

Although we often think of fungi as organisms that cause disease but these are playing a major role in revolutionizing the fashion industry. As stated above, fashion is the prevailing style of dress or behaviour at any given time, with the strong implication that fashion is characterized by change. Today fashion has widened its scope considering its diverse areas. Certainly, the number of people following fashion increased greatly in the modern era, especially, due to the spread of democracy and the rise of industrialization. This review has revealed that apart from being looked upon as potential harmful pathogens or as antibiotic producers, fungi can be uniquely used in presenting the fashion in different areas textile, cosmetics, medicines, food and agriculture. Hence, an attempt has been made to connect the biotechnological role of fungi in diverse areas of life style while fundamentally targeting the fashion.

## CONFLICT OF INTEREST STATEMENT

Author1 declares that he has no conflict of interest.

Author2 declares that she has no conflict of interest.

## COMPLIANCE WITH ETHICAL STANDARDS

This article does not contain any studies with human participants or animals performed by any of the authors.

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APPENDICES

Figures



**Figure 1: Wedding Dress Produced Using a Combination of Tree Mulch and a Naturally White Fungus**



**Figure 2: A 'living garment' Made from the Orange Bracket Fungus**



**Figure 3: Origins Plantidote Mega-Mushroom Treatment**



Figure 4: Alqvimia Eternal Youth Containing *Schizophyllum Commune*



Figure 5: Mushrooms: The food Delight for the Adventurous Cook

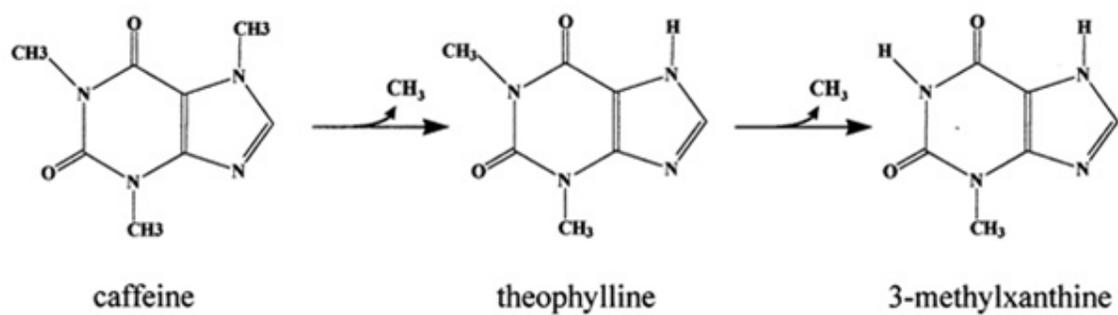


Figure 6: Demethylation of Caffeine