1. INTRODUCTION

Clothes are considered as the second skin of the human kind. It plays a vital role after food, and before shelter. The textile and clothing industry is one of the oldest and largest in the world, from the evidence that ancient civilizations used clothes made of natural fibers. The textile and clothing industry is a diverse and heterogeneous industry which covers an important number of activities, from the transformation of fibers to yarns and fabrics, to the production of a wide variety of products. Textiles have such an important bearing on our daily lives that every one needs to know something about them. Since time immemorial, people have been using textiles of various types, from covering the body for modesty, for warmth, for personal adornment, to display of personal wealth.

Over the years, India has emerged as a successful outsourcing centre for textiles and apparel. Indian textile and apparel industry is gaining in strength with a spurt of growth in investments and modernization to meet the surging world-wide demand. World class plants with the capacity to manufacture fibers and yarns attract heavy investments, continuous innovations, new product mix and strategic marketing. Now textile industries all over the world are facing challenges in the field of quality and productivity, due to the globalization. The highly competitive atmosphere and the stringent ecological parameters have ensured that the prime concern of the textile processor is quality and environment. Again, the guidelines for the textile processing industries by the pollution control boards create concern over the eco-friendliness of the processes. This in turn, makes it essential for innovations and changes in the processes. As a result, the research and development strategies of the textile processors will be highly focused and the challenges will force many changes in the textile industry.

In this context, the textile industry is seeking innovative production techniques to improve the product quality. Society as well requires new finishing techniques with regard to the environmental aspect. Since long, man has made use of textiles of various types, for a variety of purposes. Today, they are still used for these purposes and everyone is the ultimate consumer. This is an industry which gives rise to a host of pollutions. Factories discharge dyes and chemicals into waterways, release heat, fly ash, and formaldehyde, sulfurous and nitrous compounds into the air, thereby contributing to acid rain. Textile packaging and toxic chemicals are dumped into landfills. Even the used fabrics themselves are a problem. Many can not be recycled due to their mixed-fiber content.

Eco-friendly products are highly beneficial to our health as also to the environment. The quality of our lives can be greatly improved with the use of these green products that are made from natural raw materials. Eco-friendly products refer to products and services that are made of chemical-free raw materials, the manufacturing of these products causes minimal harm to the
environment. More and more people are going green and contributing in their own small ways to preserve nature and the beauty of the earth, as noted by www.environmentalleader.com.

The garment industry’s new drive towards high value-added products is promoted by increasing competition from other countries. So, the industry is developing textiles with smart functioning, using new products to provide extra comfort and increased performance. For example, Antimicrobial finishes can be used for preventing odor problems generated by bacteria, denotes Prasad (2007).

The word denim is almost synonymously used with high fashion garments. Denim has become so popular throughout the world; the appearance of this fabric is continuously being modified to appeal to the varied fashion trends and demands of different generations. In many aspects, fashion trends dictate how the fabrics and garments should look and accordingly the processing techniques of denim have been changed. Today, denim does not just refer to the jean alone; it refers to a variety of items in apparel accessories and embellishments with the development of varied possibilities of yarns, fabric, finishes, weaves, dyeing. A wide range of denim fabrics can be manufactured to suit the varied tastes of consumers. Creativity at the finishing stage is more important than the product. Denim is the most preferred clothing of today’s youth. Various other items of denim like pants, shirts, skirts, jackets, belts and caps are available in the market. To give the denim a distressed look, many types of washing are given to the fabric; denote Sangita et al (2010). Denim industry, like any other textile and clothing product, is largely fragmented. Westerners were the major producers of denim in past years, states Nayak (2010). The spread of denim culture all over the world, brought with it a trend of fast changing fashions and manufacturing technology. Nowadays, when it comes to eco-friendly treatments within the denim industry, there seems to be no shortage of innovative views, technological progression or investments, points out Ankodi (2010).

Denim fabric is made of 100% cotton and woven with twill weave. A traditional blue denim is a “warp faced” cotton fabric in a 3/1 twill construction. Coarse yarns are used in warp and weft. The warp is dyed a solid color, usually indigo and the weft is undyed. Because it is warp faced, the denim fabric is blue on the surface and almost white on the back, as referred by Rao (2006). Normally it is a 3/1 warp faced twill fabric made from yarn-dyed warp and a dyed weft yarn, view Denton et al (2002). Heavy cotton yarn is woven in a dense twill weave to create raw denim. The denim is then dyed or bleached, treated and preshrunk to create the desired look. Variations of cotton denim include denim Lycra blends for stretch, raw denim for durability and ramie denim for wrinkle-free softness, notes Whyte (2010).

The term “blending” is used by the yarn manufacturer to describe specifically the sequence of processes required to convert two or more kinds of staple fibers into a single yarn, composed of an intimate mixture of the component fibers.
Polyester fabrics are claimed to have a “less natural” feel when compared to natural fibers. However, polyester fabrics may exhibit other advantages over natural fabrics, such as improved wrinkle resistance. As a result, polyester fibers are sometimes spun together with natural fibers to produce a cloth with blended properties. In such denims, the polyester used in warp is kept low, to about 20-25%, because the blend is harder to dye than cotton. Polyester can be used in much higher percentage, in filling.

Poly Lycra or Spandex or elastane is a synthetic fiber known for its exceptional elasticity. It is strong, but less durable than natural latex, its major non-synthetic competitor. The fabric stretches like a knit fabric but should be sewn like denim with a heavy weight needle and polyester thread. The cotton/lycra fabric may be used for everything from jeans to leggings, the type of garment determines the pattern and fit.

A yarn consisting of an inner core yarn is surrounded by staple fibers. A core spun yarn combines the strength and/or elongation of the core thread, and the characteristics of the staple fibers from the surface, as viewed in Textile Glossary.Com.

Value-addition in clothing has changed the global textile scenario. Among anti-microbial agents available in the market for the use of textile application, many are synthetic-based and may not be environmentally friendly. Due to this, a large number of consumers are opting for herbal anti-microbial finishes for textiles. It must be ensured that these substances are not only permanently effective but also compatible with skin and eco-friendly, says Sathianarayan et al (2010). Textile products, especially made from natural fibers, have a serious problem of microorganism growth, due to their surface area and ability to retain moisture, view Mustafa et al (2010).

The use of plants and plant products could be traced as far back as the beginning of human civilization. Medicinal plants are a source of great economic value all over the world. Nature has bestowed on us a very rich botanical wealth, a large number of diverse types of plants grow in different parts of the country, explain Ripa et al (2012). The Indian Ayurvedic system of medicine is known as the richest, and the foremost among the other branches of medicinal knowledge that is available elsewhere on the globe, as pointed out by Rajeh et al (2010).

The healing value of herbal clothing and its usage is based on the principle of touch. By coming in contact with an herbal cloth, the body loses toxins and its metabolism is enhanced. Herbal clothes are completely free of synthetic chemicals and toxic irritants, and being totally organic, sustainable and biodegradable, says www.fiber2fashion.com.A major factor that has stimulated interest in antimicrobial finishes using natural sources has been the current vogue that promotes natural and eco-friendly lifestyle. In addition, the consumers are now much more aware of the
deleterious effects that microorganisms may have upon textiles and human hygiene, as viewed by Natarajan(2002). An innovative approach to make the cloth microbial resistant, is to apply the plant extracts containing active substances, as referred by Ian (2002).

Ricinus communis shows good activity against pathogenic bacterial strains Staphylococcus aureus as well as Escherichia coli. The antibacterial assay reveals that petroleum ether and acetone extracts of Ricinus communis possess a good zone of inhibition, whereas ethanolic extract displays anti-bacterial activity only on higher concentration, point out Islam et al (2006).

Euphorbia hirta can be used to treat skin disorders and dengue fever. It is an infectious disease, spread by mosquitoes in tropical areas. The Euphorbia hirta contains antiviral and antibacterial properties say www.wisegeek.com. The anti-microbial activity of the alcoholic extract of Euphorbia hirta leaves show antipyretic, analgesic, antibacterial, anxiolytic, anthelmintic, antifertility, antispasmodic, antifungal, and anti-inflammatory activities, and it also has antibacterial activities.

The Senna auriculata root is used in decoctions against fevers, diabetes, diseases of the urinary system and constipation. The leaves have laxative properties. The dried flowers and flower buds are used as a substitute for tea in case of diabetes patients. It is also believed to improve the complexion in women. The powdered seed is also applied to the eye, in case of chronic purulent conjunctivitis.

Multi-functional finishing is defined as treating textile fabrics with two or more finishing agents in a combined bath, in a single step. Multi-functional finishing therefore results in savings, both in terms of energy usage as well as water consumption. The intent was to impart value-added protective properties, point out Ajoy et al (2011). The UV-protection and the antibacterial properties, against S. aureus (G+ve) and E. coli (G−ve) bacteria, of the simultaneously finished and dyed fabric samples are maintained even after 15 washing cycles, as viewed by Ibrahim et al (2011). In recent years, several technologies have been developed for modifying cotton blends and cotton as multi-functional textiles. Surface modification of cotton fabrics can impart wrinkle-free finishes, self-cleaning properties, anti-microbial activity, UV protection, and flame retardancy, say Hanumansetty et al (2012).

The first concept of “antibacterial finishing for textiles” emerged in 1941. The use of antimicrobials dates back to ancient Egypt, where these were used in the treatment of mummies, say Bohringer et al (2000). The term ‘antimicrobial’ refers to a broad range of technologies that provide varying degrees of protection for textile materials against micro-organisms. Antimicrobials are very different in their chemical nature, mode of action, impact on people and the environment, handling characteristics, durability, costs, regulatory compliance, and their interaction with micro-organisms. The number of bio-functional textiles with an antimicrobial activity has increased considerably over
the last few years. The awareness of health and hygiene among consumers has increased the demand for antimicrobial textiles which have antimicrobial finishes, in particular to protect against fungal diseases. Textiles worn next to the body have to be treated with a variety of different applications due to medical and hygienic risks.

Microbial infestation cannot be removed by even the most frequent washing, with the exception of washing at boiling temperature, which is not suitable (or practical) for textiles. Extensive efforts have been made to control infections caused by micro-organisms and therefore, a large demand exists for antimicrobial finished textiles, capable of avoiding (or) limiting microbial fiber degradation, odor generation, as well as bacterial incidence and spread.

Antimicrobials are of two types: Leaching (conventional antimicrobials) and Non-Leaching type. Each Antimicrobial finish displays three common traits: safe to the environment, safe to the wearer, and antimicrobials effective, and is classified as either leaching or non-leaching. It is a general term, that is used to indicate the negative effect of the product on the vitality of micro-organisms, say Ramachandran et al (2004). Textiles are carriers of micro-organisms, such as pathogenic bacteria, odor generating bacteria, mould and fungi. These micro-organisms can adhere to textile substrates. Additionally, the environmental conditions on the textiles are favorable, and thus support bacterial growth.

While several bacterial static textile finishes already exist for personal wear, their use for this purpose has not gained ready acceptance. Poor activity against mold and mildew, lack of wash durability, inadequate safety data to meet current requirements, or a combination of these factors has hampered their use. Consequently, a safe, wash-resistant textile finish, capable of inhibiting the growth of both bacteria and fungi, is required. Growth of a micro-organism implies an increase in the amount of protoplasm, the formation of new structures, and eventually, the formation of new cells. The synthetic activities of microbes that ultimately result in cells, maybe considered from two perspectives-how much growth has occurred and how far it has been accomplished.

Micro-organisms are small forms of life, which generally cannot be seen by the human eye. They consist of single (or) multiple levels of cells and can be found in very cold (or) hot climates worldwide, say Nadiger and Gotmare (2011). Textiles are an excellent substrate for bacterial growth and microbial proliferation under appropriate moisture, nutrient and temperature conditions. The term fungi describe a taxonomic classification of organisms, but no longer include organisms such as slime molds and water molds, that had traditionally been considered to be fungi.

Mosquito repellent textiles are one of the revolutionary methods in the advancement of the textile field, by providing the much-needed features of driving away mosquitoes, especially in the tropical areas. Textiles will have desirable aesthetic qualities if they can suppress odor causing
bacteria and other types of odor causing micro-organisms. The hygiene and medical effectiveness of textiles is required to prevent the growth of dermatophytic fungi (those that cause skin diseases), pathogenic and potentially lethal micro-organisms on fibers and to prevent their infestation by insects.

The textile industry utilizes micro encapsulation, a technology that uses microencapsules, which serve as tiny containers of substances. The substance, liquid or solid, is released to fulfill a specific purpose. It is similar to a capsule, in fact, a coating, referred to as the wall, shell or membrane, surrounds the material inside. “The content of the microencapsules can be released in a variety of ways, depending on the characteristics of the capsule wall, including physical pressure, friction, diffusion, wall dissolution, and biodegradation.

Micro encapsulation of natural materials is one of the methods used to increase the durability of the antimicrobial finish on the textile materials. In this technique, the active compounds are encapsulated, using a wall material, like modified starch, sodium alginate, gum acacia, etc, and applied on the textile materials. Micro encapsulation technologies offer plenty of opportunities to improve the properties of fabrics, to obtain and enhance new functionalities, as viewed by Sudha et al (2006).

Many different methods have been proposed for the production of microencapsules, depending on core and wall thickness and wall permeability, type and release of core contents required, physical properties and overall economics of manufacture. Some of the important processes used for micro encapsulation are as follows: interfacial polymerization, in-situ polymerization, coacervation, co-extrusion and fluidized-bed technology.

Nanotechnology is a science which deals with matters having one or more dimension of less than 100 nm. It is in use in many areas. Information, communication, paints, textiles, medicines, cosmetics, sunscreens, etc, are few examples. The nanotechnology applied in textile industry is still recent. Worldwide forums direct textile manufacturers towards nanotechnology for a better understanding of the purpose of this science. Nanotechnology allows fabrics to obtain special properties like: anti-microbial, anti-UV, self-cleaning, nanoencapsules of moisturizing agents, deodorizing, repellent, and others.

In the field of textiles, nanotechnology provides new characteristics to yarns and fibers. Nano-apparel products have already emerged in the market and the number of products which utilize nanotechnology have increased, states Nascimento et al (2008). There are many techniques for applying these nano coatings: such as layer by layer coating through self assembly. There are many ways in which the surface properties of a fabric can be manipulated and enhanced, by implementing
appropriate surface finishing, coatings, or altering techniques, using nanotechnology, say Sawhney et al (2008).

Environmental pollution appears to be a necessary evil of all development. An eco-friendly approach to control antibacterial, antifungal, anti odor and mosquito repellency is warranted. The safer natural products, being eco-friendly, easily bridgeable and cost effective, are the focus of the study as an alternative to conventional chemical insecticides. The above finish will be applied on 100% cotton and blended denim fabric by different methods such as conventional Dip, Pad-dry-cure, Microencapsulation and Nanoencapsulation.

Hence the present study "A study on the effect of multifunctional finishes on blended denim fabrics" is taken up with the following objectives.

- To elicit information from the market and the consumer to find out the availability and utility of denim fabric.
- To screen for functional properties such as Antibacterial, Antifungal, Anti odor, Mosquito Repellency, Microencapsulation and Nanoencapsulation from selected herbs.
- To optimize the effective herbal combination of the functional property of the selected finishes.
- To finish the optimized herbal combination on the four selected denim fabrics.
- To evaluate the properties before and after wash of the finished fabrics.