The development of new materials and the enhancement of existing materials to develop skin regeneration are wide areas of research in polymeric biomaterials. The paper presents the analysis of a wide range of several natural polymers such as proteins and polysaccharides which can be utilized for skin tissue repair and regeneration. The reviews look at the few examples of commercially available natural origin polymers with applications in tissue engineering. Natural polymers, such as proteins and polysaccharides, being components of, or structurally similar to, the glycosaminoglycans in the extracellular matrix (ECM) are valuable materials for tissue engineering applications. Natural polymers have great coincidence to natural ECM elements, particularly in biocompatibility and biodegradability. In this paper, the attention is focused on several natural polymers that found application in research work for drug or cell delivery within the skin tissue engineering field, namely collagen, chitin, chitosan, alginate, gelan, gelatin, and curcumin.

Keywords: Skin tissue engineering, Extracellular matrix, Regeneration, Biomolecules, Drug delivery.
from these sources has been evaluated for their prospective application as a substitute for mammalian collagen [31].

CHITIN

Chitin is a natural polysaccharide found mainly in the shell of crustacean, cuticles of insects and cell walls of fungi. It is the second richest polymerized carbon available in natural ants, as well as the second highly abundant natural biopolymer after collagen. It has been widely exploited due to its ECM-mimicking character and one of the degradation products, namely N-acetyl-D-glucosamine and reported supporting fibroblast proliferation and structured collagen deposition [Fig. 1] [32]. Chitin also promotes macrophage movement and stimulates the deposition of granulation tissue and also has revealed a function in vascularization and good hemostatic action [33]. Optimal biomedical design focuses on the use of bioinert materials to minimize inflammatory response alleviated by unknown body reactions, thus, chitin, being bioactive and bioinert would be a proper candidate. Chitin, due to its less quantity of 2-amino-2-deoxy-D-glucose, is less soluble in acidic solvents, deficient in the property of protonation [34]. The abundant hydroxyl group and the N-acetyl group that are associated with inter- and intra-molecular hydrogen bonding explain the high crystallinity of such aggregates.

Use of chitin in wound healing dressings arises from the ability of N-acetyl-glucosamine to speed up the rate of tissue repair, and to avoid the development of scars and reduction of the skin [35]. It is invoked as a powder in the beginning, at present it is being incorporated into a variety of materials such as films and membranes, gels, and woven and non-woven dressings [36]. The high crystallinity of chitin compromises the mechanical integrity of such scaffolds. The latter was found to be particularly suited to the treatment of burns, cutaneous lesions, and ulcers, and skin grafts for their high-quality of absorbance, adhesive character, and permeability to oxygen [36-38].

CHITOSAN (CHN)

CHN is a biopolymer fully or partially deacetylated form of chitin and consisting of glucosamine and N-acetyl-D-glucosamine (Fig. 2) and has been extensively exploited for biomedical and tissue engineering applications (skin, bone, cartilage, and vascular grafts to substrates for mammalian cell culture) due to its affirmative properties such as non-toxic, renewable, biocompatibility, biodegradability, non-antigenic, and bioactivity [39-41]. The gelation of CHN takes place at body temperature and CHN having the ability to interact with growth factors and hold proteins, makes it a significant material for tissue engineering [42,43].

The degradation of CHN is limited by the remaining amount of acetyl component, and it quickly degrades in vivo conditions. All these favorable characteristics made CHN an attractive material for tissue engineering [40]. However, in CHN scaffolds, the porosity can be restricted which affects the strength and elasticity of the tissue engineering scaffold [44].

The cationic nature of CHN enables it to interact with negatively charged polymers such as HYA to form a polyelectrolyte complex (PEC) through ionic bonding. The HYA and CHN are prone to swelling individually and therefore do not produce stable scaffolds. However, the formation of PEC causes the construction of constant and dynamic scaffolds [45]. Thus, formed scaffolds will improve the properties of the individual polymers such as increased stability, superior cell attachment, and enhanced mechanical property [42].

ALGINATE

Alginate is naturally occurring anionic and hydrophilic polysaccharide. It is one of the most abundant biosynthesized materials, and water-soluble biopolymer is extracted from brown seaweed and bacteria [43]. Alginate contains blocks of (1–4)-linked β-D-mannuronic acid (M) and α-L-guluronic acid (G) monomers (Fig. 3). Naturally, the blocks are composed of three different forms of polymer segments: Successive G residues, successive M residues, and alternating MG residues.

Alginate is of particular interest for a wide variety of applications as a biomaterial and particularly as the sustaining matrix or delivery system for tissue repair and regeneration. Due to its wonderful properties in terms of biocompatibility, biodegradability, non-antigenicity, and chelation ability, alginate has been extensively used in a variety of biomedical applications including tissue engineering, drug delivery and in some formulations preventing gastric reflux [44]. The result of naturally available polysaccharides, alginate exhibits a pH-dependent anionic nature and has the capability to react with cationic polyelectrolytes and proteoglycans. Therefore, delivery systems for cationic drugs and molecules can be obtained through easy electrostatic interactions [46].

Alginate has been used in a number of wound dressings [47]. Alginate-based wound dressings such as sponges, hydrogels, and electrosprun mats are promising substrates for wound healing that suggests many reward including hemostatic capability and gel-forming ability on absorption of wound exudates [48,49]. Alginate has found to acquire numerous significant elements attractive in a wound dressing such as good water absorptive, conformability, optimal water vapor transmission rate, and gentle antiseptic properties coupled with
Gelatin is a derivative of collagen and usually obtained by the controlled hydrolysis of collagen extracted from animal tissues, such as skin and bovine and porcine bone. Gelatin is better-quality in its biological properties, ease of processing into microspheres, gentle gelling performance, controllable degradation through the optimization of cross-linking and the presence of the great quantity of functional groups that can be further derivatized and modified [56].

The electrostatic nature of collagen is hardly modified through the acid process because of a less invasive reaction to amide groups of collagen. As a result, the isoelectric point of gelatin that is obtained with the acid process will remain similar to that of collagen [57]. Using gelatin carriers for cell delivery as showed to become also a promising technology for tissue engineering applications. Several examples include bovine and human chondrocytes [58], mesenchyme stem cells [59], and human adipocytes [60]. The strategies range from the coimpregnation of loaded microspheres [60] to the incorporation of cells into porous scaffolds [61] and, in general, the in vivo results show the higher effectiveness of using gelatin carriers-based technology. Gelatin is generally applied in the pharmaceuticals industry for drug delivery, with many orally delivered capsules being based on gelatin. Gelatin and other natural polymers have been studied in vivo and in vitro for their potential in pulmonary drug delivery and sustained release [62].

Gellan gum is a linear anionic polysaccharide composed of repeating units of glucose, glucuronic acid, and rhamnose [50,51]. It exists in the acetylated form, which is the initial raw material, and the deacetylated form, which is the most frequently used [52,53]. Gellan gum is nontoxic and can be simply processed without the use of insensitive reagents into transparent gels that are resistant to heat and acid stress [54]. Gellan gum gels are frequently utilized in the food industry as thickening agents or stabilizers. In the biomedical field, most applications are recommended for drug delivery approaches [55].

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CONCLUSION
Skin tissue engineering aims to restore, repair the diseased or damaged tissue. Polymeric biomaterials have several important uses in addition to skin tissue engineering. The bio uniqueness categorizes the natural-origin polymers as one of the most eye-catching options to be used in the tissue engineering field and drug delivery applications.

AUTHOR’S CONTRIBUTIONS
Concept and collection of data - Gowrisankar L, Usha P. Writing the article and critical review of article - Gowrisankar L, Ganesh Murari J. Final approval of the article - Gowrisankar L.

CONFLICTS OF INTEREST
Nil.

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