

**INCORPORATION AND EVALUATION OF GLYCOSAMINOGLYCAN AS
HUMECTANT IN GEL PREPARATION**

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ABSTRACT

Skin care products are designed for improving skin conditions by cleaning the skin as it is the first essential step to any daily skin care routine. Secondly, it preserves the skin moisture balance^[1] and helps in stimulating the skin metabolism.^[2] Skin care cosmetics mainly protect the skin from the harmful effects of drying, atmospheric changes, pollution etc and keep it looking beautiful and healthy.^[3,4] For maintaining the health of the skin it is important to understand the role of humectants for it.

KEYWORDS: Glycosaminoglycan, Polyacrylic Acid Polymer, Hyaluronic Acid, Glycerin, Humectant, Moisturizer, Cosmetics.

INTRODUCTION

Humectants are frequently use in cosmetic formulations as a way of increasing and maintaining hydration of the skin and hair. The single or combinations of humectants are used in several cosmetic products including shampoo, conditioner, serum, lotions, creams, lip treatments, cleansers, after-sun lotion, body lotions etc.^[5] They are essential part of cosmetic ingredient that reduces the moisture loss of skin by retaining the skin's natural moisture balance.

Humectants are hygroscopic in nature.^[6] Some humectants are even capable for holding up to multiple times their own weight of moisture. They lock moisture onto the surface of the skin making it moist and healthy.^[7] A humectant is a substance that is use to keep things moist. It is the opposite of a desiccant, whose purpose is to keep things dry. It is often a molecule with several hydrophilic groups most often hydroxyl groups but amines and carboxyl groups sometimes esterified, can be encountered as well as the affinity to form hydrogen bonds with molecules of water is crucial here.^[8]

Humectants are incorporated in cosmetics as a way of increasing and maintaining moisture in the skin and hair. In moisturizers product humectants work by attracting water to the upper layer of the skin (stratum corneum).^[9] All humectants have hydrophilic groups which allow them to participate in hydrogen bonding and attract water.^[10] Various humectants have different ways of behaving because they differ in water binding capacity at different humidity.^[11] Humectants maintain water

balance in the epidermis by acting like a sponge that holds on water.

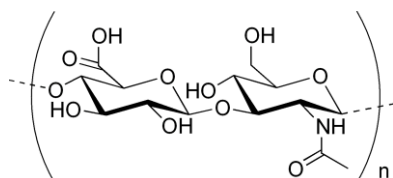
Humectant is defined as a substance that absorbs or helps another substance to retain moisture. Humectant traps water molecules when applied to the skin and help in improving hydration of the stratum corneum. However, the water that is drawn to the skin is transepidermal water, as it continues evaporation from the skin can actually exacerbate dryness.^[12] Humectants are wonderful for all skin type especially dry skin.^[13] Hydrating substances are used in cosmetic products to slow down moisture loss from the product during use. This function is generally performed by hygroscopic substances or humectants.^[14] Dry skin is essentially required a treatment with humectants.^[15]

The main objectives of this study is to incorporate glycosaminoglycan in polyacrylic acid formulation for skin care preparation.

MATERIALS AND METHODS

Glycosaminoglycan composed of a repeating disaccharide of N-acetylglucosamine and glucuronic acid.^[16] Glycosaminoglycans are highly polar in nature.^[17] Hyaluronic acid is a substance that attaches to collagen and elastin to form cartilage. Hyaluronic acid not only helps in keeping the cartilage cushions joints strong and flexible but also helps in increasing the supplies of joint-lubricating synovial fluid. Hyaluronic acid is present in every tissue of the body and it performs many important functions. It helps deliver nutrients to and carry out the toxins from cells that do not have a

blood supply such as those found in cartilage. The inadequate amount of hyaluronic acid makes joints brittle and deteriorates. Not only does it keep joints lubricated but also encourages water retention in other bodily tissues. It is present in large concentrations of the extracellular matrix which is the fluid-filled space between cells. Hyaluronic acid locks moisture into the extracellular matrix keeping collagen and elastin moist which help in promoting a youthful appearance of the skin.^[18] The glycosaminoglycan used for the present study is hyaluronic acid.



Chemical structure of Hyaluronic Acid

Hyaluronic acid is also a major component of skin, where it is involved in tissue repair. When skin is

Table No 1.

S. No	Ingredients	Function	H
1	Ultrez 21	Rheology Modifier	1.0
2	Tri ethanol amine	Neutralizer	0.6
3	Sodium Benzoate	Preservative	0.5
4	Hyaluronic Acid	Active	1.0
5	Water	Solvent	up to 100

Evaluation of Stability Parameters of Active in Gel Formulation

The stability of final formulation was observed at two different temperatures that is $45 \pm 2^\circ\text{C}$ and $10 \pm 2^\circ\text{C}$ along with the gel formulation having glycerin in same percentage as a control. Various parameters such as viscosity, pH was observed for 4 months.

There was no significant change observed in above mentioned parameters of the product at $45 \pm 2^\circ\text{C}$ and $10 \pm 2^\circ\text{C}$ temperatures. Accelerated stability studies showed that formulation with active was stable during the period of study.

Subjective Evaluation

Moisturizers have been used to alleviate dry skin they reduced Trans Epidermal Water Loss (TEWL) by promoting barrier repair, smooth exposed dermal nerve ending by creating temporary barrier and restore skin smoothness.^[20] Moisturizers are designed to make stratum corneum soft by increasing its hydration.

Moisturizer has multifunctional effect and also contain required amount of humectant in it. It includes reduction of dryness, roughness, scaling, decrease in perceived feeling of tightness and itching.^[21] During the high exposure of sun radiation or sun burn the skin become red and eventually shed or peel. Humectant help in reducing the inflammation, repair sun damage and

excessively exposed to UVB rays it becomes inflamed or sunburn and the cells in the dermis stop producing much of hyaluronic acid and this increase the rate of its degradation. Hyaluronic acid also contributes to tissue hydrodynamics movement and proliferation of cells it also participates in a number of cell surface receptor interactions.^[19]

Formulation

Gel is composed of polyacrylic acid polymer dispersed in water along with neutralizer, preservative and active ingredient. The percentage of the chemicals was adjusted to get the required formulation of the gel. The raw materials which were used in formulation are carbomer, TEA, sodium bicarbonate, hyaluronic acid etc.

Considering all above properties and uses of active, formulation of gel was selected. After various trial and errors methods formulation as per Table No 1 was selected as final formulation.

prevent wrinkle formation by balancing the water content of the skin. The moisturizing efficiency was measured in vitro by the Trans Epidermal Water Loss (TEWL) measurement. Loss of water in the skin to the outside that is Trans Epidermal Water Loss (TEWL) is measured using a device cutometer.

The Cutometer is designed to measure elasticity of the upper skin layer using negative pressure which deforms the skin mechanically. The measuring principle is based on the suction method. Negative pressure is created in the device and the skin is drawn into the aperture of the probe and after a defined time released again. Inside the probe, the penetration depth is determined by a non-contact optical measuring system. This optical measuring system consists of a light source and a light receptor, as well as two prisms facing each other, which project the light from transmitter to receptor. The light intensity varies due to the penetration depth of the skin. The resistance of the skin to the negative pressure (firmness) and its ability to return into its original position (elasticity) are displayed as curves (penetration depth in mm/time) in real time during the measurement. This measurement principle allows getting information about the elastic and mechanical properties of skin surface.^[22]

Procedure

Six volunteers in the age group of 20-25 years were selected for the study. The volunteers were allowed to

rest for at least 10-20 minutes before study, so that their blood circulation can regain a normal level. The volunteers were asked not to wash the forearm at least four hours prior to the study and not to apply any cosmetic or soap to the inner forearm during protocol.

Prior to the trials, the baseline values of the volunteers were taken using 2 x 2 cm test areas (2 cm apart) on the inner forearm. Each designated areas were then treated with standard and test formulation (dose 2 mg/ cm²) along with blank that is nothing was applied. The Trans Epidermal Water Loss (TEWL) values were measured immediately at 0 minutes and then after every 30 minutes using Cutometer.

The subjective evaluation was carrying out for a week at the same time of the day. All the values of Trans Epidermal Water Loss (TEWL) during 6 days study were

noted down. Mean of these values was calculated and plotted against time.

RESULTS

Accelerated stability studies showed that formulation with active was stable in respect to appearance, viscosity, pH, colour, appearances, odor and separation.

Subjective evaluations also indicated that volunteers were satisfied with the moisture retention property of the active. There was no significant change observed in previously mentioned parameters for the final formulations at $45 \pm 2^\circ\text{C}$ and $10 \pm 2^\circ\text{C}$ temperatures. Obtained results were tabulated and are mentioned below.

Viscosity

Viscosity indicates the consistency of the formulation.

The Comparative Values of Viscosity (cps) of Gel Formulations having Glycerin (Gly1) and Hyaluronic Acid (H) at Same Concentration kept at $45 \pm 2^\circ\text{C}$ in Table No 2

Table No 2

No. of Days	H (1 gm%)	Gly 1 (1 gm%)
0	2104	2029
16	2127	2042
30	2137	2049
45	2156	2060
60	2166	2072
90	2177	2084
120	2180	2098

The Comparative Values of Viscosity (cps) of Gel Formulations having Glycerin (Gly1) and Hyaluronic Acid (H) at Same Concentration kept at $10 \pm 2^\circ\text{C}$ in Table No 3

Table No 3

No. of Days	H (1 gm%)	Gly 1 (1 gm%)
0	2104	2029
16	2106	2036
30	2108	2038
45	2109	2043
60	2112	2051
90	2114	2064
120	2117	2073

pH

pH values determines the potential of hydrogen ions in the formulations.

The Comparative pH Values of Gel Formulations having Glycerin (Gly1) and Hyaluronic Acid (H) at Same Concentration kept at $45 \pm 2^\circ\text{C}$ in Table No 4

Table No 4

No. of Days	H (1 gm%)	Gly 1 (1 gm%)
0	6.66	6.75
16	6.67	6.77
30	6.68	6.77
45	6.68	6.77
60	6.68	6.77
90	6.68	6.77
120	6.68	6.77

The Comparative pH Values of Gel Formulations having Glycerin (Gly1) and Hyaluronic Acid (H) at Same Concentration kept at $10 \pm 2^\circ\text{C}$ Table No 5

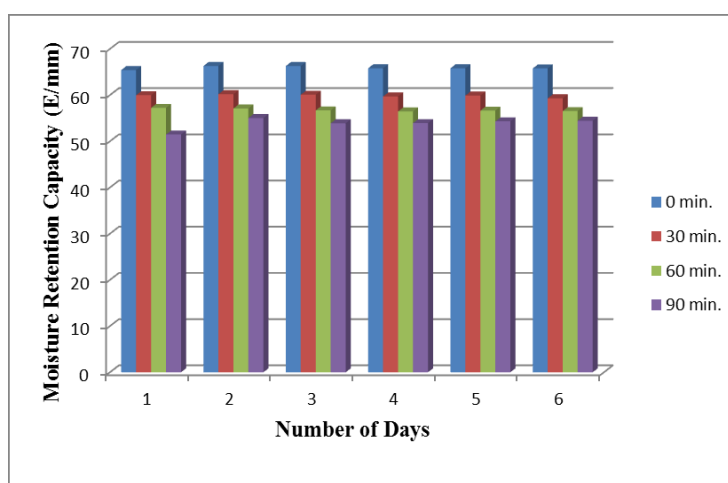
Table No 5

No. of Days	H (1 gm%)	Gly 1 (1 gm%)
0	6.66	6.75
16	6.67	6.76
30	6.67	6.76
45	6.67	6.76
60	6.67	6.76
90	6.68	6.76
120	6.68	6.76

Subjective Evaluation

The subjective evaluation was done on the group of 6 subjects. It was found that 97% of volunteers were showing that they were satisfied with the Trans

Epidermal Water Loss (TEWL) property of the products. The volunteers were comfortable throughout the study. Readings obtained from subjective evaluations shows the positive results.



Graph 1: Showing the Values of Moisture Retention Capacity (E/mm) of Gel Formulation having Hyaluronic Acid (H) (1 gm %) with respect to time (min.).

CONCLUSION

Hyaluronic Acid is a glycosaminoglycan composed of a repeated disaccharide of N-acetylglucosamine and glucuronic acid.^[23] Glycosaminoglycans are highly polar and attract water when it was used in the gel formulation as an active it shows the significant decrease in the Trans Epidermal Water Loss indicates that it is a more effective humectant than glycerin. As it was also compared with glycerin in the gel formulation, the observations of viscosity, pH, conductivity, and stability study were satisfactory.

Hence it can be conclude that-

The product is stable and shows satisfactory humectant property in gel formulation after application. Therefore the glycosaminoglycan can be used in skin care gel preparation as a humectant.

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