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Sensory Effect on Hydrogels Using Endothermic and Hydration Properties of Urea

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Introduction:

Urea, as a component of the Natural Moisturizing Factor(NMF), is a hygroscopic material that attracts and retains water molecules. In addition, urea lowers the surrounding temperature through an endothermic reaction when it is dissolved in water and changes its phase into an aqueous solution. As the exposure to heat stress increases due to environmental changes such as the aggravation of global warming and increasing outdoor activities, consumers' interest in skin moisturizing is keep increasing. The aim of this study is to show the developed moisture and the sensory properties of urea in a hydrogel, utilizing the urea's hygroscopic and endothermic characteristics.

Materials & Methods:

•Measurement of temperature change according to dissolution of urea
Dissolve the pellets of urea in deionized water 50g and measure the real-time temperature changes using a probe thermometer.

•Hydrogel composition and preparation
The hydrogel was separated into the first agent and the second agent. The first agent is an aqueous phase which made in 3% solution of sodium alginate, and the second agent is a powder phase containing calcium and urea.
To second agent into powder, milling is performed twice for 30 seconds in a grinder (HGR-2000, hibell).

• Measurement of temperature change real-time in hydrogel formulations
The temperature of the first hydrogel agent before mixing was measured using a probe thermometer, and the temperature immediately after mixing the second agent including urea was measured. Hydrogels made of second agent that do not contain urea were also measured in the same way.

•Dry content determination
Using Halogen Moisture Analyzer (METTLER TOLEDO), 10 g of hydrogel was gelled in the same size in a sample pan, and then the amount of water evaporation (%) of the hydrogel was measured when heated at 50℃ for 30 minutes.

Results & Discussion:

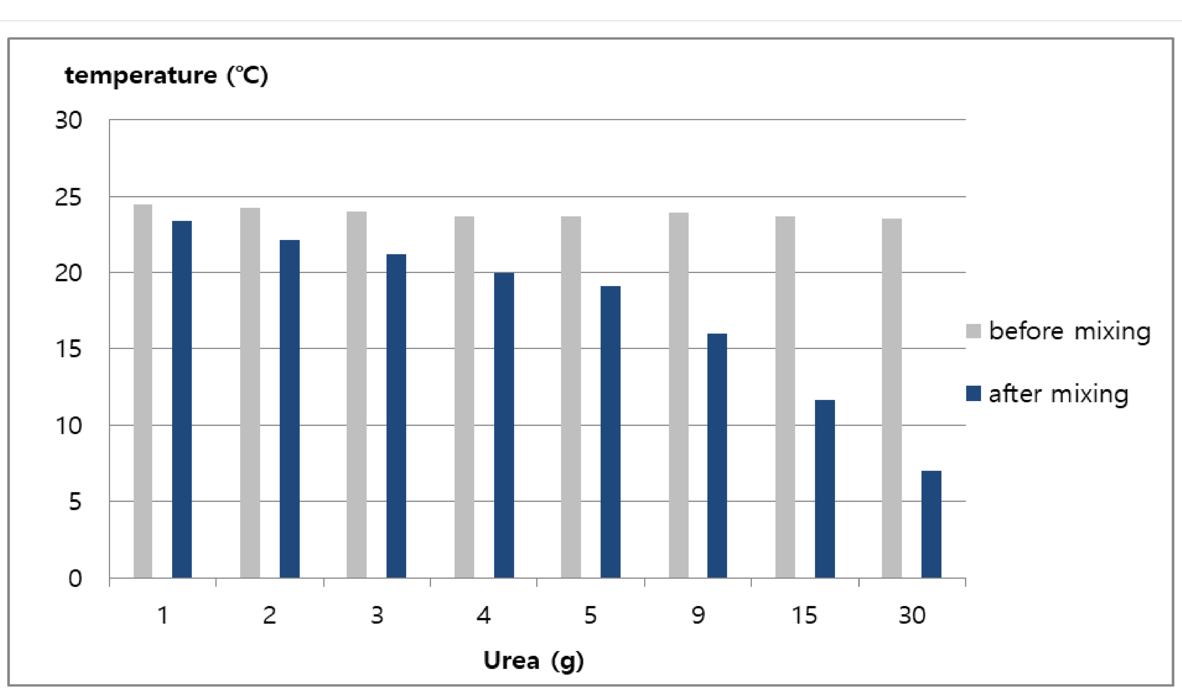

Figure 1. Temperature change before and after urea addition

Results & Discussion:

UREA (%)	2.0%	3.8%	5.7%	7.4%	9.1%	15.0%	23.1%	37.5%
ΔT (℃)	1.1	2.1	2.8	3.7	4.6	7.9	12	16.5
melting time (s)	80	100	103	88	78	125	180	660

Table 1. Temperature change according to urea concentration

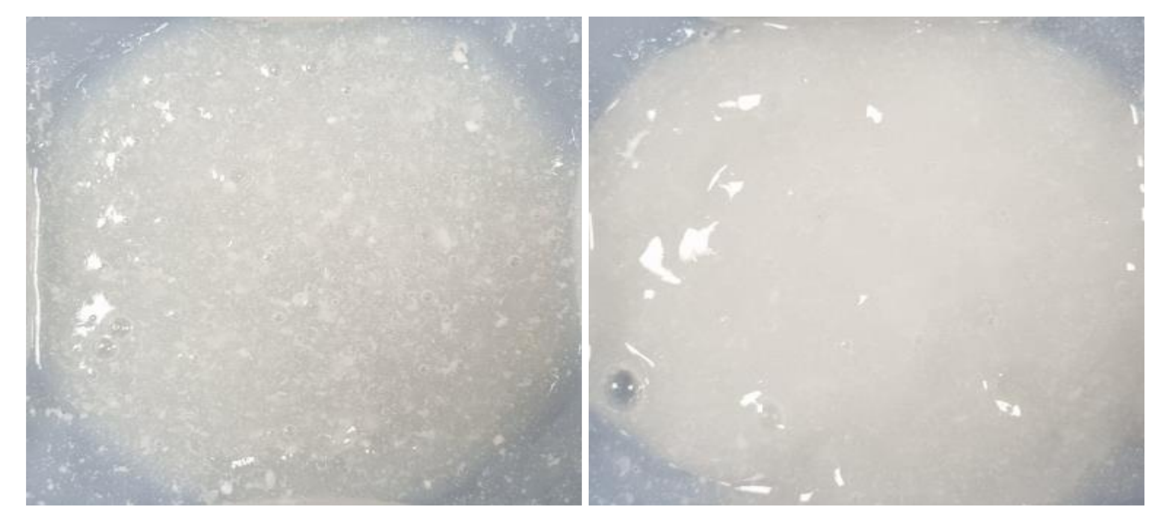

Figure 2. Effect of bulking agent of powder phase to form Hydrogel.
Left–mixed hydrogel without bulking agent, Right–mixed hydrogel with bulking agent

Due to the hygroscopicity of urea, it is difficult for a powder containing urea to be dispersed in an aqueous solution, and it interferes with the formation of a hydrogel. Bulking agent was added to the powder phase which prevent agglomeration of the powder and facilitate dispersion.

		A	B	C
second agent	UREA (%)	5.93	8	-
	gelling agent (g)	1	1	1
	bulking agent (g)	17.5	-	17.5
temperature	before mixing (℃)	22	22.7	22.7
	after mixing (℃)	14	20	21
	ΔT (℃)	8.0	2.7	1.7

Table 2. Changes in temperature before and after mixing according to the ingredients included in the second agent

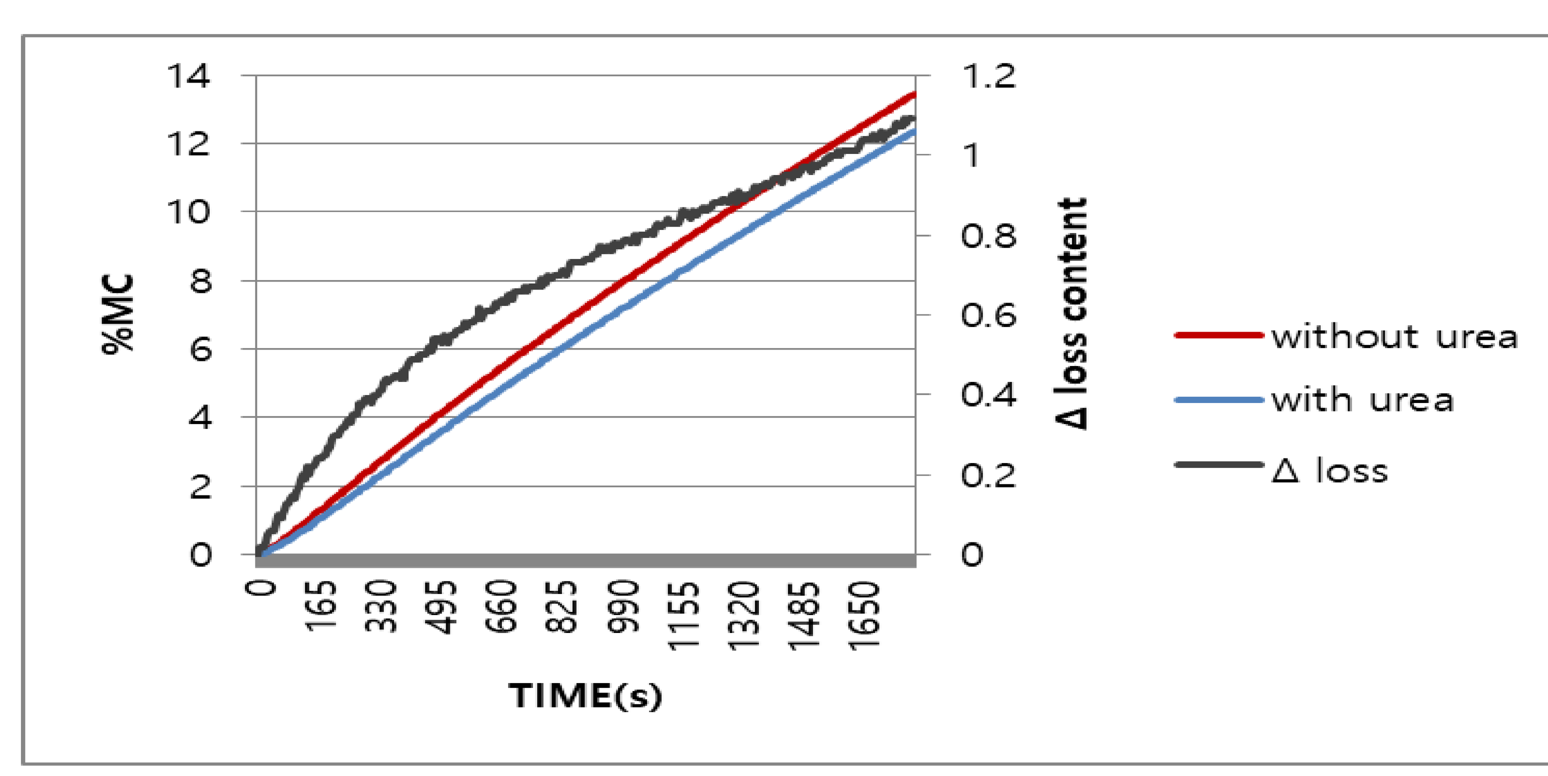

Figure 3. Change of moisture dry content with time of urea containing /non-urea containing hydrogel

Conclusions:

When incorporated into hydrogels to apply the endothermic and water-containing properties of urea, it exhibits higher endothermic and water-containing effects than adding urea to a normal aqueous formulation.

References:

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