

# SYNTHESIS AND PROPERTIES OF AMPHOTERIC HYDROXYETHYL STARCH DERIVATIVES

Miglė Babelytė, Joana Bendoraitienė, Ramunė Rutkaitė

Department of Polymer Chemistry and Technology, Kaunas University of Technology, Lithuania  
[migle.babelyte@ktu.edu](mailto:migle.babelyte@ktu.edu)

Amphoteric starch contains both cationic and anionic groups in the same molecule. Generally, cationic starch derivatives are starch ethers prepared by using tertiary amino or quaternary ammonium groups containing reagents. Meanwhile, anionic starches can be synthesized by introducing phosphate, phosphonate, sulfate, sulfonate or carboxyl groups into starch molecules. The synthesis of amphoteric starches might be achieved by applying two different approaches, namely, firstly anionic modification and thereafter cationic modification or firstly introduction of positively charged groups and then anionic modification. The main applications of amphoteric starches are in the paper industry as wet-end additives and viscosity modifiers in construction industry [1]. In addition, amphoteric starches can be used in cosmetic industry as thickeners or emulsion stabilizers.

The aim of the present work to prepare amphoteric hydroxyethyl starches (CHES/AHES) of different composition and to investigate their polyelectrolyte complexes formation in water by using natural green coffee bean extract.

Preparation of CHES/AHES has been achieved by using cationic and anionic modifying reagents by two - step reaction as demonstrated in the synthesis scheme in Fig. 1.

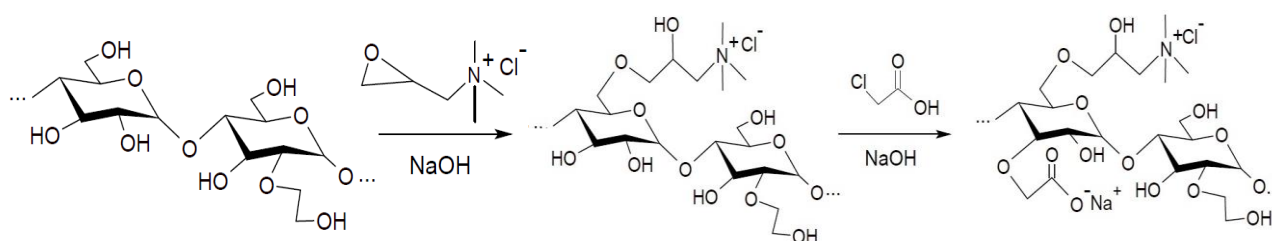


Fig. 1. Two – step synthesis scheme for preparation of amphoteric starches

Firstly, cationic hydroxyethyl starch (CHES) was prepared by the reaction of hydroxyethyl starch (HES) with (2,3-epoxypropyl)trimethylammonium chloride (EPTMAC) in the presence of sodium hydroxide at 45°C for 24 h [1]. The molar ratio of the HES : EPTMAC : NaOH : H<sub>2</sub>O was 1 : 0.35 : 0.04 : 3 aiming to obtain CHES with a degree of substitution (DS) of 0.29. Synthesized CHES then were reacted with monochloroacetic acid (mCIAA) in alkaline solution at 55 °C for 48 h. By using molar ratio of the CHES : mCIAA : NaOH : H<sub>2</sub>O equal to 1 : 1-1.5 : 2.4-3.6 : 90, the CHES/AHES with the degree of substitution (DS) of anionic groups equal to 0.27 and 0.55 were obtained (Table 1).

Table 1. Characteristics of amphoteric hydroxyethyl starch derivatives

Amphoteric hydroxyethyl starch derivative	Molar ratio				DS of CHES	DS of AHES
	CHES	mCIAA	NaOH	H <sub>2</sub> O		
CHES <sub>0.29</sub> / AHES <sub>0.27</sub>	1	1	2.4	90	0.29	0.27
CHES <sub>0.29</sub> / AHES <sub>0.55</sub>	1	1.5	3.6	90	0.29	0.55

Water soluble amphoteric hydroxyethyl starch derivatives can form polyelectrolyte complexes with cationic or anionic compounds due to the presence of anionic and cationic groups in the same molecule. The polyelectrolyte complex formation in water between water soluble amphoteric hydroxyethyl starches and components of green coffee bean extract have been investigated. By changing pH and concentration of amphoteric hydroxyethyl starch and green coffee bean extract in water the complex particles were obtained and characterized thereafter.

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[1] R. Rutkaitė, J. Bendoraitienė, R. Klimavičiūtė, E. Lekniūtė, I. Narmontaitė, V. Šinkūnaitė (2012). Charged starch nanoparticles prepared by polyelectrolyte complex formation, *Chemija*, Vol. 23. No. 4, 328 – 335.