# Discussion

The tensile test and adhesion test suggested that the PVA124-TA (0.625%) hydrogel with twice freeze-thawing cycles had better tensile properties and tensile strength. Although the adhesion of PVA124-TA (0.625%) hydrogel with twice freeze-thawing cycles was slightly lower than that of freeze-thawing for once, its mechanical property was greatly improved. PVA124-TA (0.625%) hydrogel which was freeze-thawing for three times had the strongest mechanical property, however, its adhesion decreased significantly, which did not meet the ideal characteristics of wound dressings. Therefore, the PVA124-TA (0.625%) hydrogel with twice freeze-thawing cycles is the most suitable preparation condition for the application in wound dressings.

With the increase of TA content in hydrogels, the transparency of hydrogel was decreased and the mechanical property was improved. The primarily reason is that, TA, as a cross-linking agent, provided a large number of phenolic hydroxyl groups, which could form more chain entanglements between PVA molecular chains. When TA content was 2.5wt%, the PVA molecular chains are closely cross-linked, leading to the stratification of the hydrogel. Previous research suggest that the weight loss of pure PVA hydrogel is obvious in two temperature ranges, which indicates that there are crystalline and amorphous regions in its structure. With the increase of TA concentration, the two weight loss curves of PVA hydrogel gradually become fuzzy, leading to more uniform gel structure which damages the crystal structure of PVA (Hassan, C. M. et al., 2000).

Andrade et al. believe that the antioxidant effect of TA was due to the fact that TA formed a complex with copper, which inhibited the oxidation of ascorbic acid and then inhibited the generation of OH. (Zhan, K. et al., 2017). The result of antioxidant property test in this study is consistent with previous researches (Hong, K. H., 2017). Theoretically, the antioxidant activity of the PVA-TA hydrogels would enhance with the increase of TA concentration. Nevertheless, the antioxidant activity of PVA-TA hydrogel is slightly declined when TA concentration is 2.5wt%, which is probably due to the reduction of O-phenol tri-groups caused by the crosslinking between TA.

The mechanical property test of PVA-TA hydrogel indicates that the tensile strength of hydrogel increased and the elongation at break decreased with the increase of freezing-thawing times. It is possible that the increase of freezing-thawing times leads to the formation of more cross-links between PVA and TA, which result in the increase of the hardness and fracture of hydrogel. Similarly, the adhesion of hydrogel decreased with the increase in the freezing-thawing times. According to previous studies, the gallol-tethered polymer exhibits a seven-fold stronger adhesion than the adhesive force obtained by the catechol-conjugated polymer (Zhan, K. et al., 2017). Hence, it is likely that the increase of hydrogen bond and van der Waals force formed between PVA and TA as well as other intermolecular leads to the decrease of catechol group in TA and hydroxyl group in PVA, which cause the adhesion ability of PVA124-TA hydrogel decreases.

In conclusion, the PVA124-TA hydrogel prepared by freeze-thawing approach in this study exhibit moderate adhesion ability and mechanical property, which could be a excellent candidate for wound dressings.