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Changes in the Water-Holding Capacity, Extractability of Proteins and pH Value of Ovine Muscle During Storage

Young-Seok Chae
Gang Weon National University
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貯藏中緬羊筋肉內에서의 保水性, 蛋白質抽出性 및 pH의 變化

蔡 榮 錫
江原大學校 農科大學
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ABSTRACT

This study was undertaken in order to observe the differeces of the changes in the water-holding capacity (WHC), extractability of proteins (EP) and pH value of ovine muscle during storage.

WHC decreased gradually after slaughter, reached to minimum at about 2-4hr after death as well as that of pH value and then these were recovered along with the progress of the storage.

The same tendency was observed in EP but the degree of the changes in pH value up to 6hr after slaughter was more rapid than that of WHC and EP. After the fourth day, the rate of recovery in WHC, EP and pH value in ovine muscle during storage showed similar pattern.

要 約

本實驗에서는 貯藏中에 緬羊筋肉內의 保水性, 蛋白質 抽出性 및 pH에 對한 變化의 差異를 觀察하였다.

保水性은 pH値와 같이 屠殺後 서서히 低下되어 約 2-4時間後 最少値에 到達하였다가 그 後 貯藏의 進行과 더불어 回復되였다. 蛋白質抽出性도 같은 傾向을 보였으나 屠殺後 6時間까지 pH値의 變化는 保水性 및 蛋白質 抽出性의 變化보다 더 빨랐다. 10日間貯藏中 保水性, 蛋白質抽出性 및 pH値의 回復의 速度도 같은 樣相을 보였다.

INTRODUCTION

It is important to know what changes occur when muscle goes into rigor. Especially, a factor known to influence tenderness is the WHC of meat proteins. WHC have been shown to be closely related to the pH value of the muscle (1, 4). Several investigators have found a definite effect of pH on the water retention. Hamm and Grau (3) found that the sequestering effects

of some phosphates resulted in an increase of water retention and the WHC properties of meat at various times post mortem (5). They found that the higher WHC of prerigor compared to post regor meat could be largely attributed to its high pH and consequent enhanced hydration (5).

Some changes of hydration were detracted by measuring cooking losses or by measuring weight losses during storage, freezing, etc (3, 8). The present study was conducted in an effort to determine if there is any difference in WHC and EP from storage muscles as well as changes in pH at various times during storage.

EXPERIMENTAL

1. Meat source

The muscle used throughout experimental was obtained from 3 years-old sheep. Muscles employed in this study consisted of semimembranous and longissianus muscles from them.

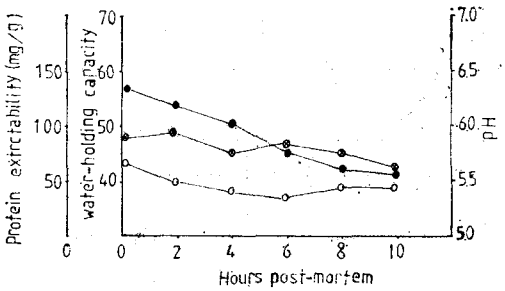

Fig. 1. Changes in WHC, EP and pH value on ovine muscle at 2°C for 10 hours after slaughter.
—○— water-holding capacity
—⊗— extractability of proteins
—●— pH value

2. Water-holding capacity measurement

The WHC was determined by the method of Wierbicki el al. (10) with the following modification. The dimension of the tubes were 180mm long with top chamber 35mm and the bottom chamber 20mm in diameter (outside).

Meat samples were 20g. Each meat sample was run twice in duplicate. The heating times and temperature were used in an oven at 70°C for 1hr. After heating the samples were centrifuged at 900 G (1000rpm) for 20min and the amount of juices lost during heating and centrifugation measured. This loss of juices is expressed as percent of the total weigt of the samples.

3. Protein extractability of muscle

The protein concentration in the supernatants of the homogenates after WHC measurements was determined and the protein extractability expressed as mg protein/g muscle.

4. pH determination

Sample 5g was homogenized in 10ml of distilled water with a Waring Blendor for 3min. The pH of the muscle homogenate was determined a Hitachi-Horiba pH meter F-7 at 20°C.

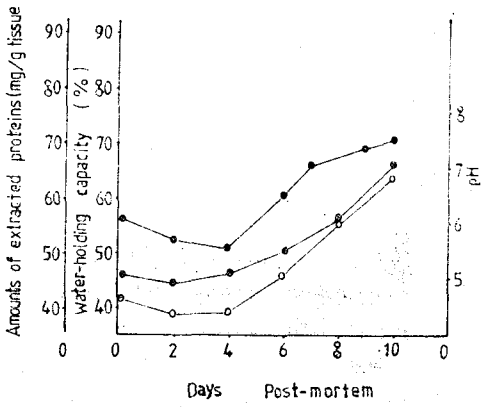

Fig. 2. Changes in WHC, EP and pH value on ovine muscle stored at 2°C for 10 days.
—○— water-holding capacity
—⊗— extractability of proteins
—●— pH value.

RESULTS & DISCUSSION

In Fig. 1 pH value, WHC and EP are plotted against time postmortem for muscles of sheep. The pH dropped steadily as well as a function of time postmortem. The protein extratability remained constant for 4.5 hours, but after which it decreased by about 30% for ten hours. The WHC dropped gradually to four hours and after this time it remained constant. The decrease in WHC coincided with a decrease in EP, so it was assumed that this decrease in WHC was caused by decreased EP, which was caused by interactions between actin and myosin filam-

ents (2, 6). Similarly the fall in pH normally occurs in all kinds of meat after slaughter. The ultimate pH value was 5.8 and the trend of pH changes of the sample was similar to the changes of WHC and EP but the rate of pH fall was shown faster than others. The rapid fall of pH caused loss of ATPase activity, the increase of early mortem glycolysis and result of normal onset of rigor mortis which have been associate with loss tender muscle (7). Consequently, The pattern of decrease in EP coincided with a decrease in WHC, so it is concluded that as the pH of postrigor muscle drops with a consequent decrease in the WHC, this indicates that the relative effect of the EP might have correlation with the changes as well as that of pH and WHC. This might be due to the changes of hydration, ATPase activity, and especially, actomyosin in muscle. However, Fig. 2 shows the very different properties of muscles from hours changes in WHC, EP and pH value. At certain intervals during ten days storage, WHC, EP and pH value showed a decrease up to around the second day on WHC, EP but the fourth day on pH value after slaughter. After that dates these increased drastically until the tenth day and these showed similar pattern for all three measurements.

It was noted by many researchers that these fall of three measurement at initial period after slaughter were due to actin-myosin interaction changes while aging process advance (9).

The same general relationship between WHC, EP and pH value as presented in Fig 2 have been shown to take the restoration for the lost functions while aging process advanced.

Therefore, these findings indicate that WHC, EP and pH value are quite similar and equally reliable in determining muscle quality.

However, it seems desirable to probe the profound correlations between the present phenomenon changed during storage.

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