Influence of Some Factors on Changes of Water Holding Capacity of Beef Muscle

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Grinding of meat as well as addition of sodium chloride increase water holding capacity /WHC/. These facts are known from experience and there are enough data about it in the literature.

It is quoted that loss of weight is greater in pieces of beef /and pork/ several times than in the ground meat of the same quality /1/. Hamm states several authors who have found that the degree of grinding of meat is in relation to WHC /3/. Trumić obtained similar results /5/.

The investigations of the influence of the sodium chloride on WHC are also numerous, but, the results of these investigations can be expressed with data stated by Hamm /3/ that 5% of NaCl provokes maximal WHC in meat without added water, and 8% when is added 60% of water to meat.

WHC of meat is changed after the slaughter - the greatest is immediately after the death, during the rigor mortis is the lowest /3, 4/ and after the rigor mortis it increases again /3/.

These phenomenons are explained in several papers, especially in papers by Hamm /2,3/.

In spite of the fact, that there are more publications on WHC of meat, we have decided to examine the changes of WHC in beef ground at different time post mortem in various degree, as well as, when adding different quantities of salt.

Experiments

Material: For investigation m. longissimus dorsi of stears and heifers were used. Those were domestic red coloured breeding - domestified simenthal, - of baby beef type, aged about 18 months, except in two samples, when used from cows of the same breeding, aged about 5 years.

Animals were stunned with the captive-bolt pistol, then bleeded and dressed in ordinary way. Muscle was taken off from lumbal region weighed about 4 kgs. The samples were trimmed of connective and fatty tissues, and on 3, 24, 48, 72, 96 and 120 hrs post mortem prepared for examination.

For every period there were prepared two samples, from different animals, except for sample prepared 48 hrs post mortem, when was used only one sample. Every sample was prepared at 10 variety as follows:

I variety, ground in 5 mm holes plate grinder
II " " " 2 mm " " "
III " " as in var. II then in cutter at 5 slow rotations
IV " " " " " III plus with 5 quick rotations
V " " " " " III plus with 10 quick rotations
VI " " " " " V with 1% added sodium chloride
VII " " " " " " 2% " " "
VIII " " " " " " 3% " " "
IX " " " " " " 4% " " "
X " " " " " " 5% " " "

Muscles were ground with combined grinder and silent cutter, "Zwilling", production Alexsanderwerk, SMZ, 20/82.

From the samples were taken for every variety amount of 150 g of meat ground in corresponding way. To every amount of varieties from I to V was added 30 ml of dest. water /20%/, and to the amount for varieties from VI to X 30 ml of dest. water with 1 to 5% sodium chloride. After adding water or salt solution the content was mixed in a glass of 250 ml volume. So prepared material was kept in refrigerator at + 4° C during examination, i.e. during 120 hrs.

Methods: WHC and pH were determined in all 10 varieties of every sample. WHC was measured by method of Grau and Hamm /3/ and pH in aqueous extract 1 : 10, with glass electrode in Philips' pH-metre, Modell 9400.

Results and discussion

The obtained results are classified according to the varieties as the material was prepared. In the paper are presen-

ted the results of examination of I, V, VI, VII and X varieties in figures designed with the numbers from 1. to 5. for WHC and from 1-1 to 5-5 for pH. Half of the obtained results is omitted because presenting all of them the paper would be of to big extent.

In the first group of samples/varieties from I to V/, excluding the samples prepared 3 and 48 hrs. post mortem, the lowest WHC had the samples ground in I variety, when this value reaches 15 cm^2. In other varieties WHC, in general, is similar and decreases to 11 and 12 cm^2, respectively. However, the influence of grinding is more significantly expressed diminishing the differences of WHC in various samples, because the higher degree of grinding declines the difference between these values. The greatest distance between the curves of WHC in variety I /Fig. 1./ is about 5 cm^2, and between the samples prepared according to the variety V /Fig. 2/ is about 2,5 cm^2.

However, the distance between the curves of pH values in different samples of these five varieties is great, and in all of them is similar in general - the values are varying from 5,3 to 6,0. Besides, it should be shown that the variation of pH is significant in individual samples, and especially in those prepared 120 hrs post mortem. These variations of pH in different samples, as well as in the same show that there is no coincidence in course of WHC and pH, and this confirmes the earlier obtained result /4/ that in some samples the coincidence is not expressed in changes between WHC and pH, in the range of pH from 5,4 to 6,2.

Consequently, results obtained in this part of examination show that when meat is ground minuter the differences in WHC are decreased in samples prepared in different times post mortem, while the differences in pH remain unchanged in these ones.

In the other group of samples, prepared by addition of sodium chloride/varieties VI - /, of which the sample prepared 48 hrs post mortem should be separated as one with the greatest WHC, is found that by the addition of a greater quantity of sodium chloride WHC increases. Increasing the added amount of NaCl the range of WHC-curves is reduced in different samples. In the VIth variety's samples with 1% of NaCl, VIIth with 2%,

VIIIth with 3%, IXth with 4% and Xth with 5% is determined the lowest WHC on 12 cm^2, 7,9 cm^2, 6,4 cm^2, 5,6 cm^2, respectively /Fig. 3., 4. and 5./. In the samples of VIII, IX and X varieties WHC is very similar, that indicates that the addition of NaCl from 3 to 5% has the similar influence on WHC in general, regardless to the preparation time post mortem.

However, the effect of sodium chloride on pH is expressed so, that by the increasing of the amount of added salt the pH is raised from 5,35 to 5,55 and more, and at the same time the distance between pH curves is diminished at the various samples prepared in different time post mortem from 0,6 to 0,4 /Fig. 3., 4. and 5./.

Diminishing pH variation in an individual sample, by increasing the quantity of NaCl, is most significant in sample,

prepared 120 hrs post mortem, where the greatest variation between two measurement in VI variety was 0,75 /Fig.3./ and in X the difference was 0,43 /Fig. 5./.

Samples prepared 3 and 48 hrs post mortem were excluded in this analize because the origin of first were cows aged about 5 years and the other one was spoiled during examination. In such way it could be explained that the first sample has lowest/varieties II, III and IV/, or very low /varieties I and V/ WHC /Fig. 1. and 2./. The course of changes of WHC in samples prepared 3 hrs post mortem was characteristic in some way. In variety I /Fig.1./, immediately after the grinding, WHC was 3,4 cm^2, in variety II 4 cm^2 and in varieties, III, IV and V /after grinding in silent cutter/ the samples didn't release the water at all. In other varieties of this samples, WHC ranged from 7 to 11 cm^2 immediately after grinding. However, in varieties from this sample WHC decreased quickly so, that 8, respectively 24 hrs after preparation it falls below the values of other samples /varieties II, III and IV/ or was among the lowest values of examined samples /varieties I and V; Fig.1. and 2./. This result is in accordance with the data that WHC of muscle significantly decreases for the first 8 to 10 hrs post mortem /3,4/.

In varieties VI to X, containing sodium chloride, WHC is on the level of the average of other samples /Fig.3., 4. and 5./. The effect of sodium chloride on increase of pH in

this sample is expressed significantly, because it increases in relation to increasing amount of added salt. In variety VI /Fig.3./ pH measured 72 hrs after preparation is 5,49, and in variety X 5,88 /Fig. 5./.

Sample prepared 48 hrs post mortem demonstrate the highest WHC in all varieties. Such a result was provoked by the growth of bacterias that, probably, has for consequence the cleavage of proteins. In same sense was the effect of increasing pH, except in varieties with 3 to 5% of added sodium chloride during last three measurements. In these varieties pH wasn't as high as in others during three last measuring, because the added salt acted so, that inhibited the growth of bacterias.

Summary

In this work is examined the influence of grinding and sodium chloride on WHC of m. longissimus dorsi of beef, prepared, 3, 24, 48, 72, 96 and 120 hrs post mortem. The samples were taken from the stears or heifers, of domestic red coloured beef - domestified simenthal breeding-in baby beef type, aged about 18 months /except for two samples from the cows of the same breeding, aged about 5 years/. At each time post mortem there were prepared two samples /48 hrs post mortem was prepared only one sample/ in 10 varieties, from which first five were ground at different degree, and other five samples with various quantities of sodium chloride /1 to 5%/. 20% of dest. water was added to the ground meat of all varieties. In this paper are presented the results of I, V, VI, VII and X varieties on the figures denoted with numbers, 1. to 5. for WHC and with the numbers 1-1 to 5-5 for pH.

Obtained results show that by the increasing the degree of the grinding WHC increases, but at the same time it doesn't provoke the raise of pH. So, it is not found coincidence between the changes of these two values. The addition of NaCl in quantity of 3 to 5% has generally the same effect on the increasing of WHC, as well as on the diminishing of its variations in different samples. These quantities of sodium chloride increase pH, and decrease the distances between the pH values, of different samples, as well as, in the same samples.

Résumé

Dans ce travail on a examiné l'influence du minçage et du sel sur le pouvoir de rétention d'eau et pH dans le muscle Longissimus dorsi des boeufs, préparé 3, 24, 48, 72, 96 et 120 heures post mortem. Les échantillons sont pris des jeunes boeufs, de la race Simental domestiquée, dans le type de baby beef, âgés jusqu'à 18 mois /excepté deux échantillons des vaches de même race, agées de cinq ans/. On a préparé deux échantillons en même temps post mortem / 48 heures post mortem n'est préparé qu'un échantillon/ en dix variantes: les cinq premières sont de différents degrés de monçage, et les cinq dernières sont avec différentes quantités du sel /1 - 5%/. Dans toutes les variantes on a ajouté 20% d'eau distillée à la viande mincée.

On a présenté les résultats de la I^{ère}, V^{ème}, VI^{ème}, VII^{ème} et X^{ème} variante sur les figures avec la numération de 1. a r. pour le pouvoir de rétention d'eau, et de 1-1 à 5-5 pour pH.

Les résultats obtenus indiquent que le pouvoir de rétention d'eau s'augmente par le minçage plus intensif,mais que ceci ne provoque pas d'élévation du pH. On n'a pas trouvé de coincidence entre ces deux propriétés. Le sel fait augmenter le pouvoir de rétention d'eau, et quand il est ajouté en quantité de 3 à 5% provoque, généralement, la même augmentation du pouvoir de rétention d'eau, et aussi le rapprochement de cette propriété chez les différents échantillons.

Ces quantités du sel font élever le pH et diminuer les différences entre les valeurs de pH des différents échantillons, ainsi que dans le même échantillon.

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Fig. 1. WHC of samples of m.L D prepared as I variation 3,24,48,72,96 and 120 h post mortem

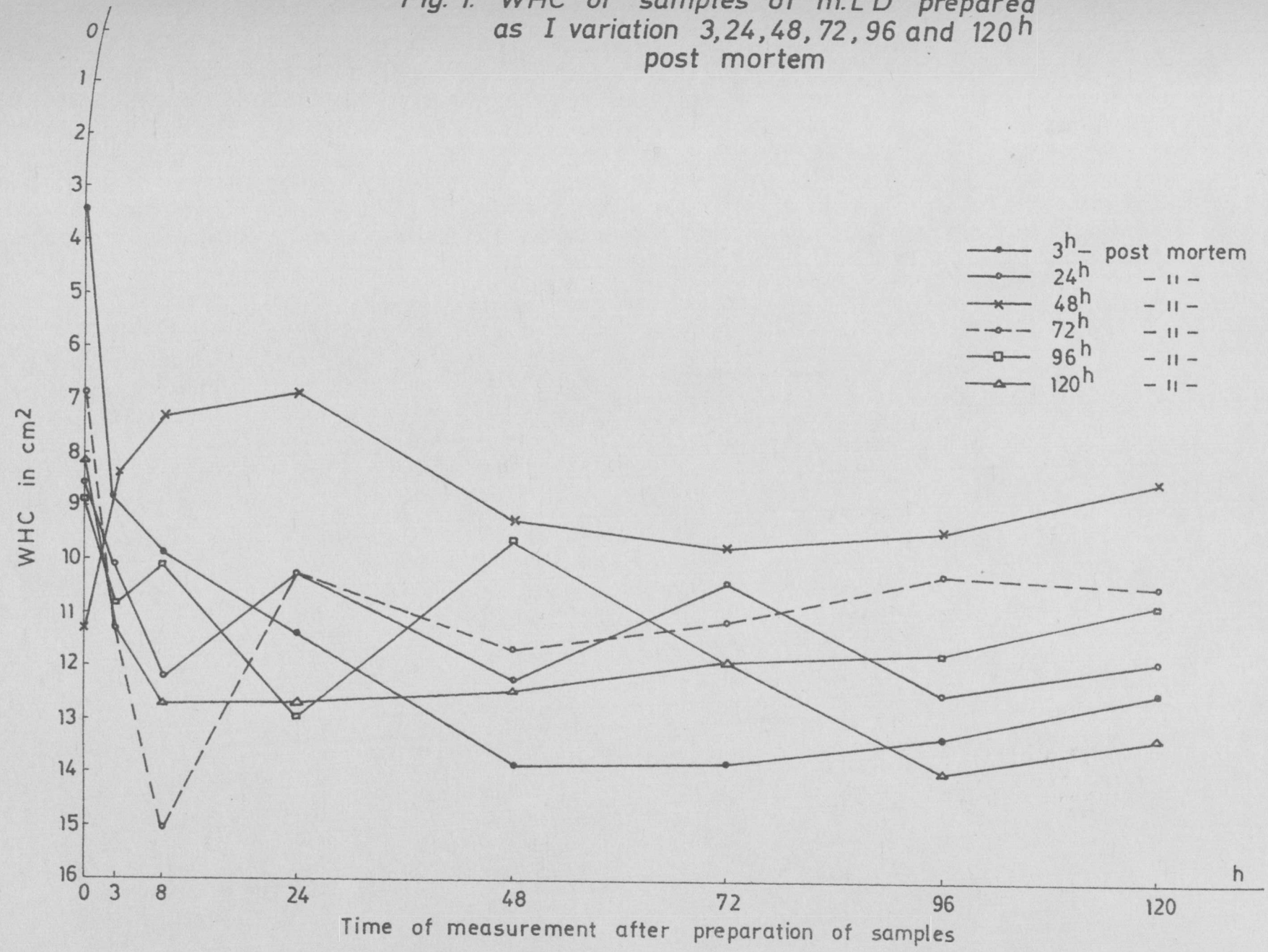

Fig. 2. WHC of samples of m.L D prepared as V variation 3, 24, 48, 72, 96 and 120h post mortem

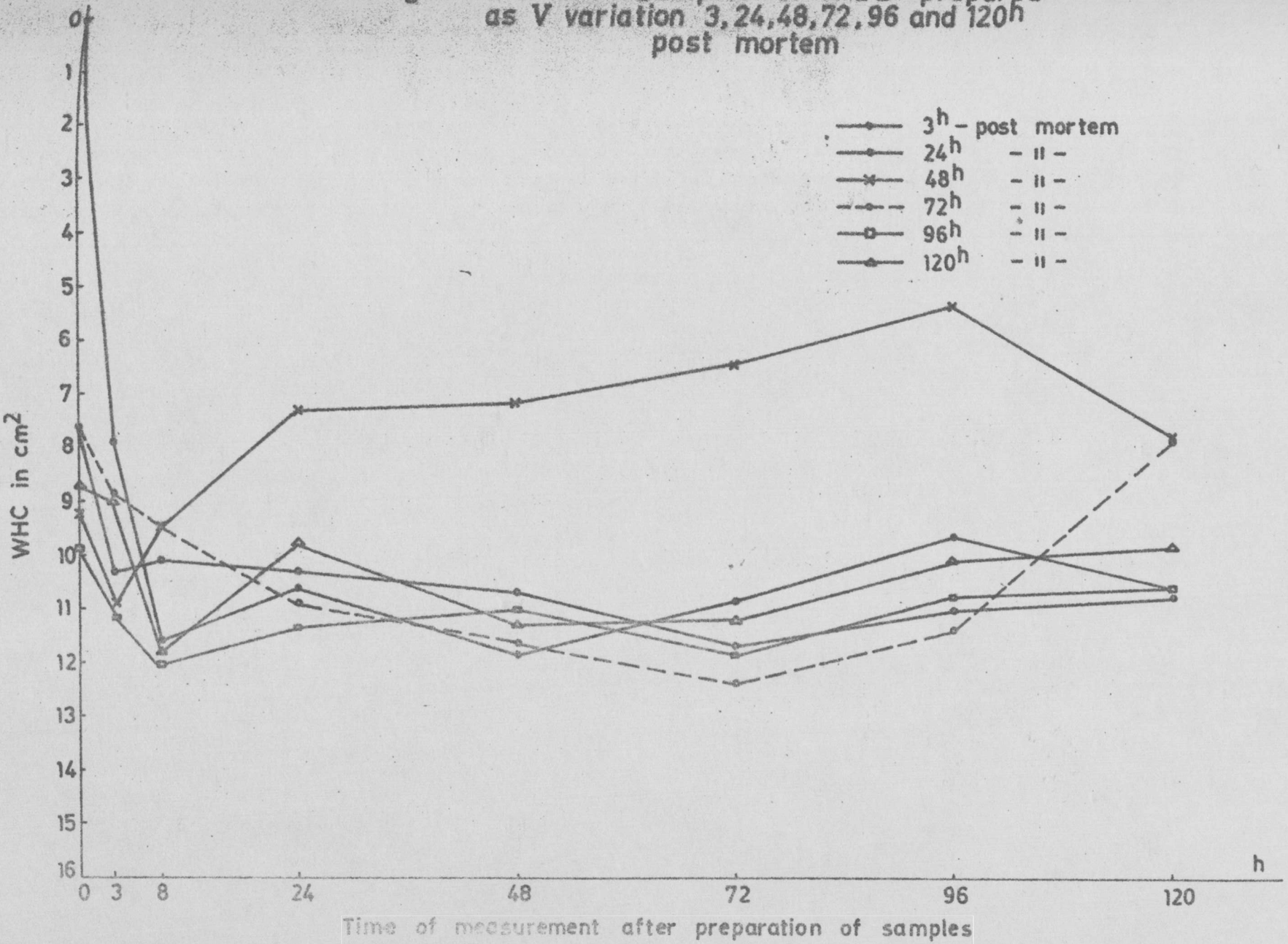

Fig. 3. WHC of samples of m.L D prepared as VI variation 3,24,48,72,96 and 120h post mortem

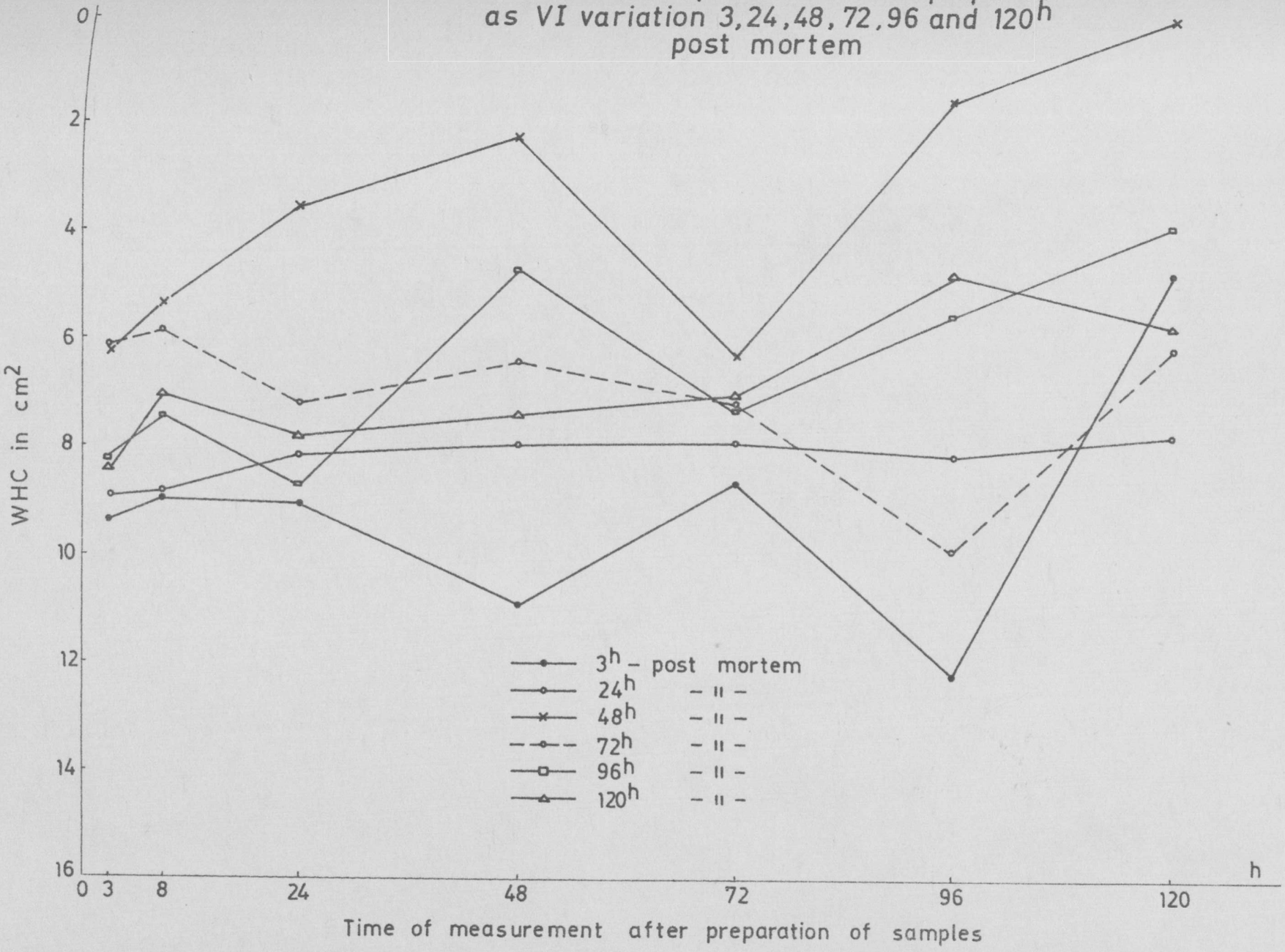

Fig. 4. WHC of samples of m.L.D prepared as VII variation 3,24,48,72,96 and 120h post mortem

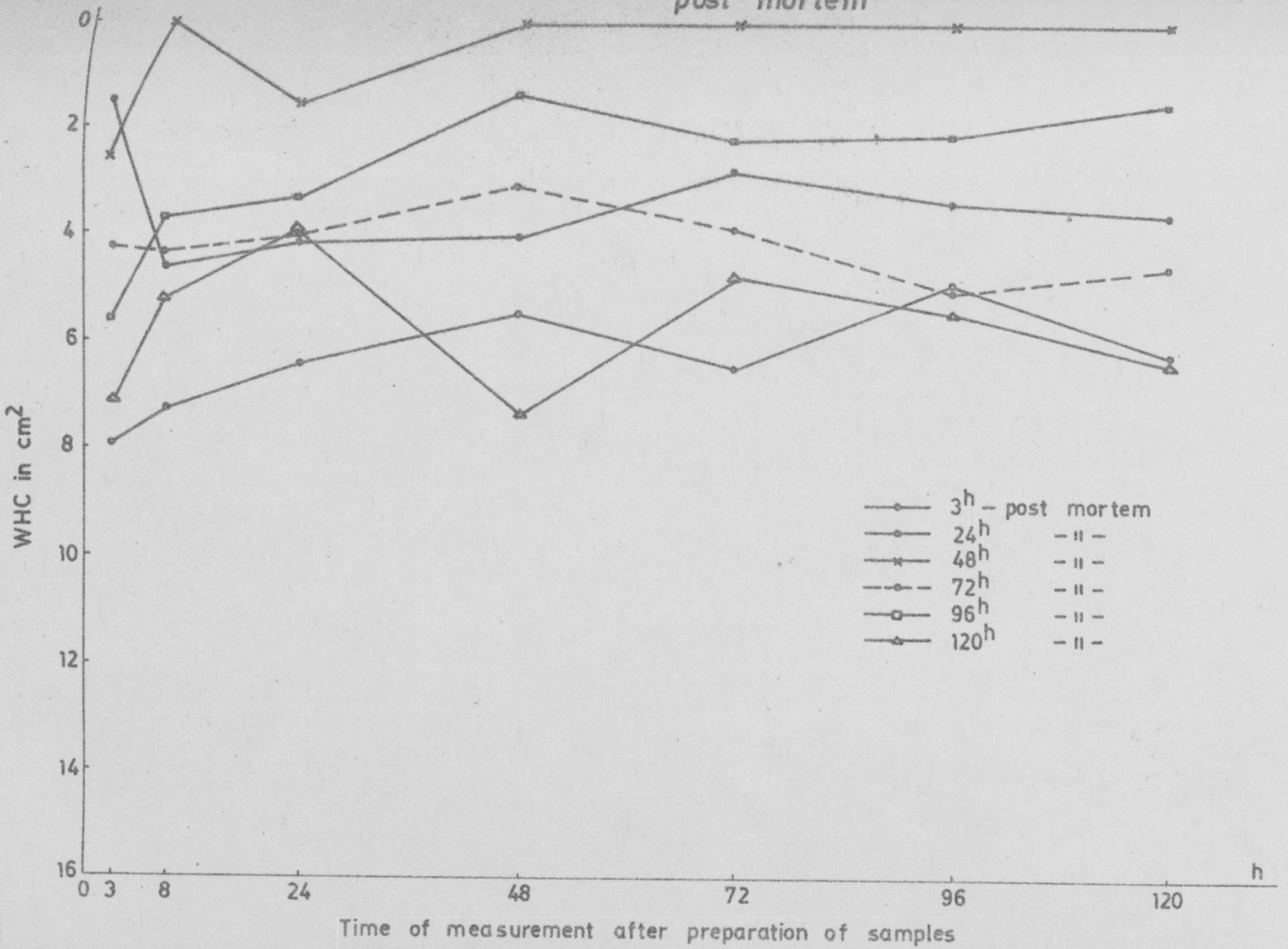

Fig. 5. WHC of samples of m.L D prepared as X variation 3,24,48,72,96 and 120 h post mortem

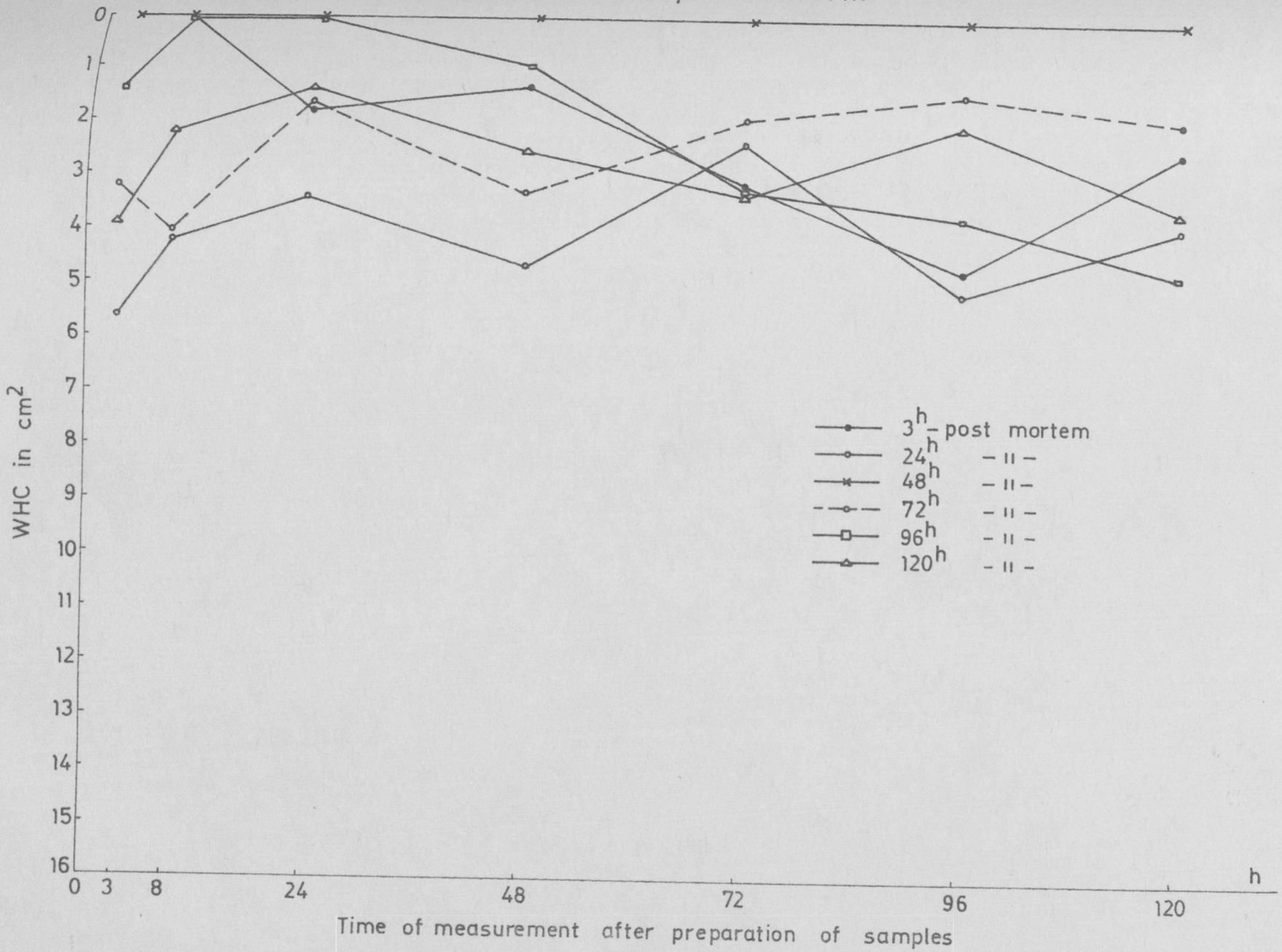

Fig. 1-1. pH of samples of m.L D prepared as I variation 3, 24, 48, 72, 96 and 120^{h} post mortem

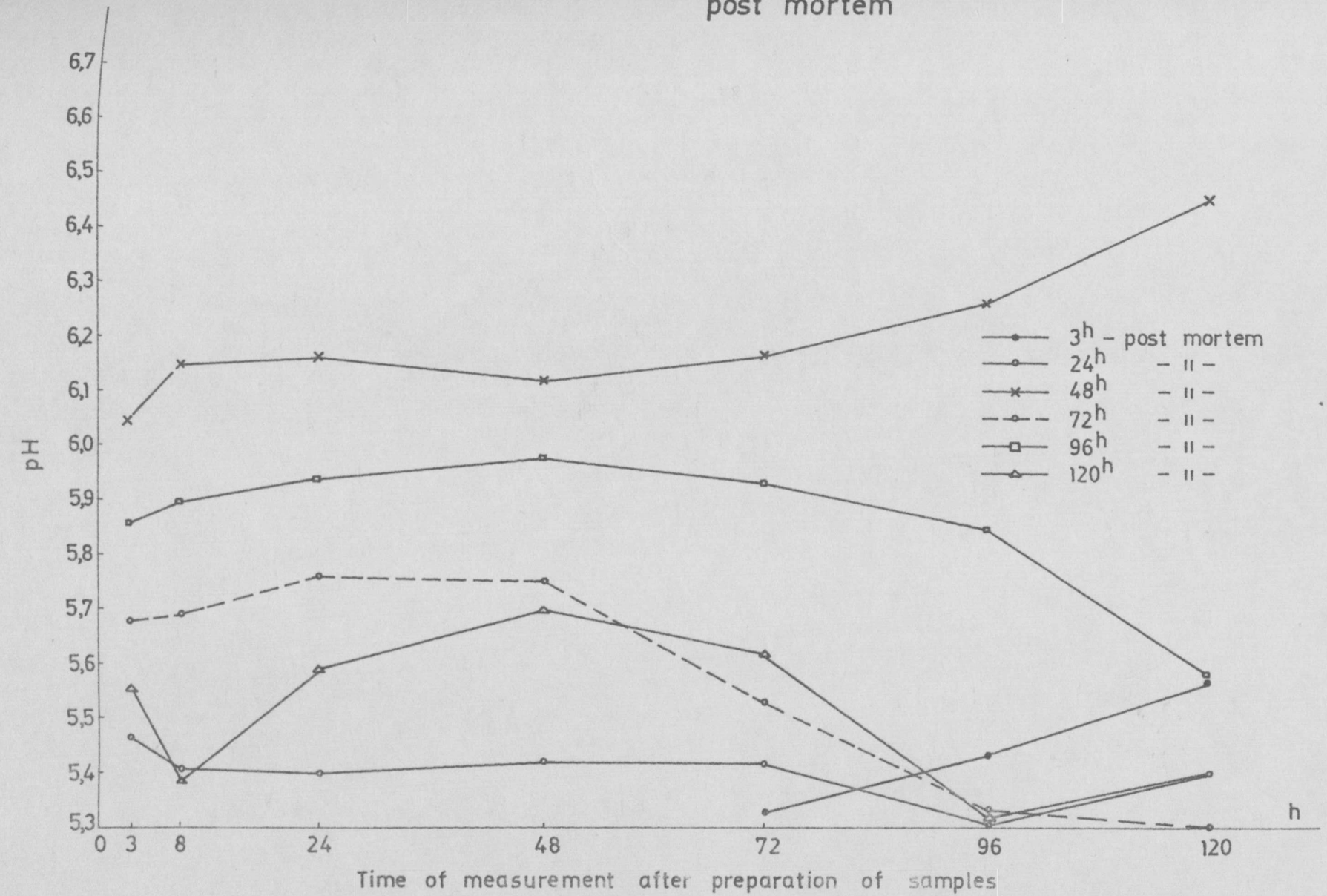

Fig. 2-2. pH of samples of m.L D prepared as V variation 3,24,48, 72,96 and 120 h post mortem

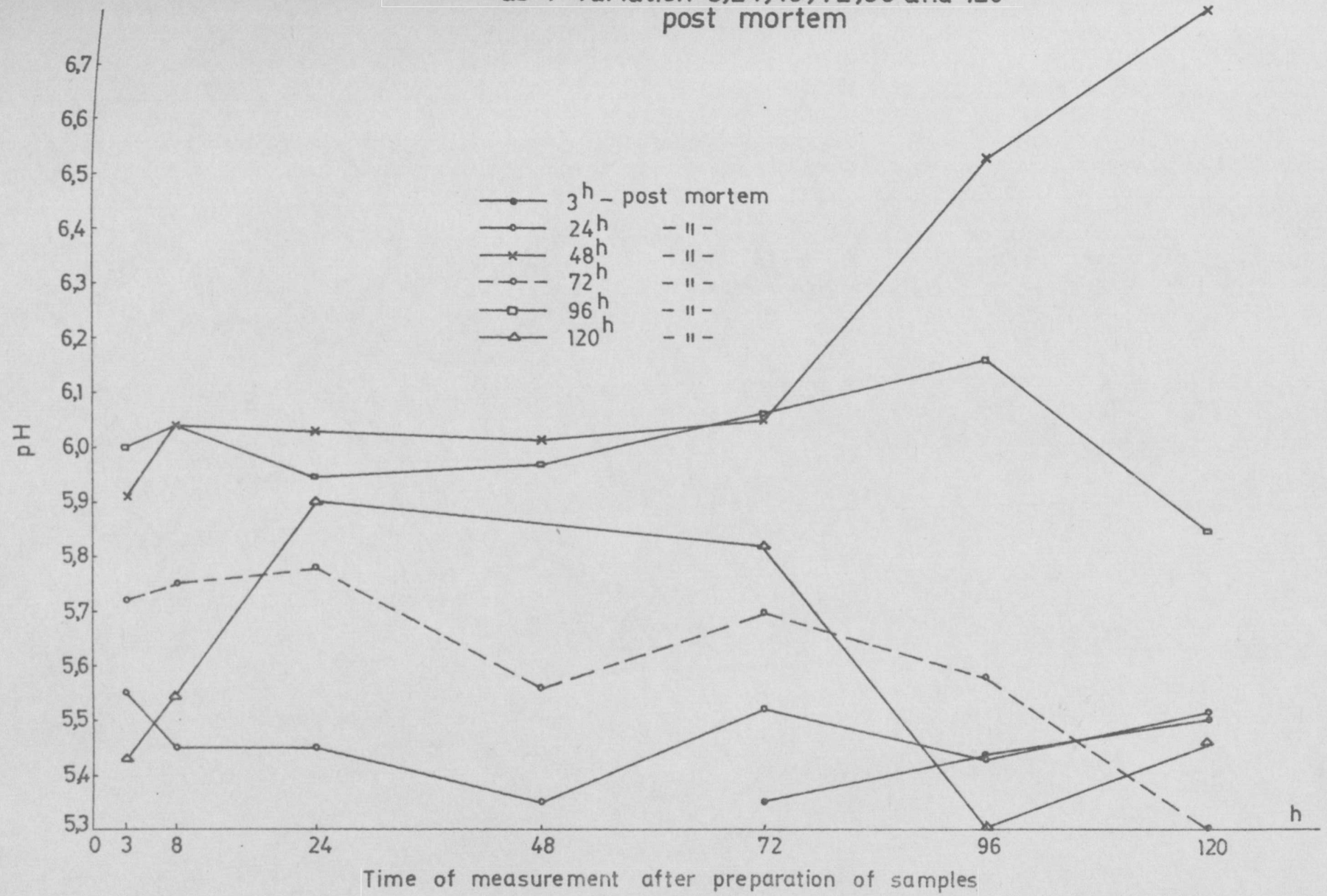

Fig. 3-3. pH of samples of m.L.D prepared as VI variation 3,24,48,72,96 and 120^h post mortem

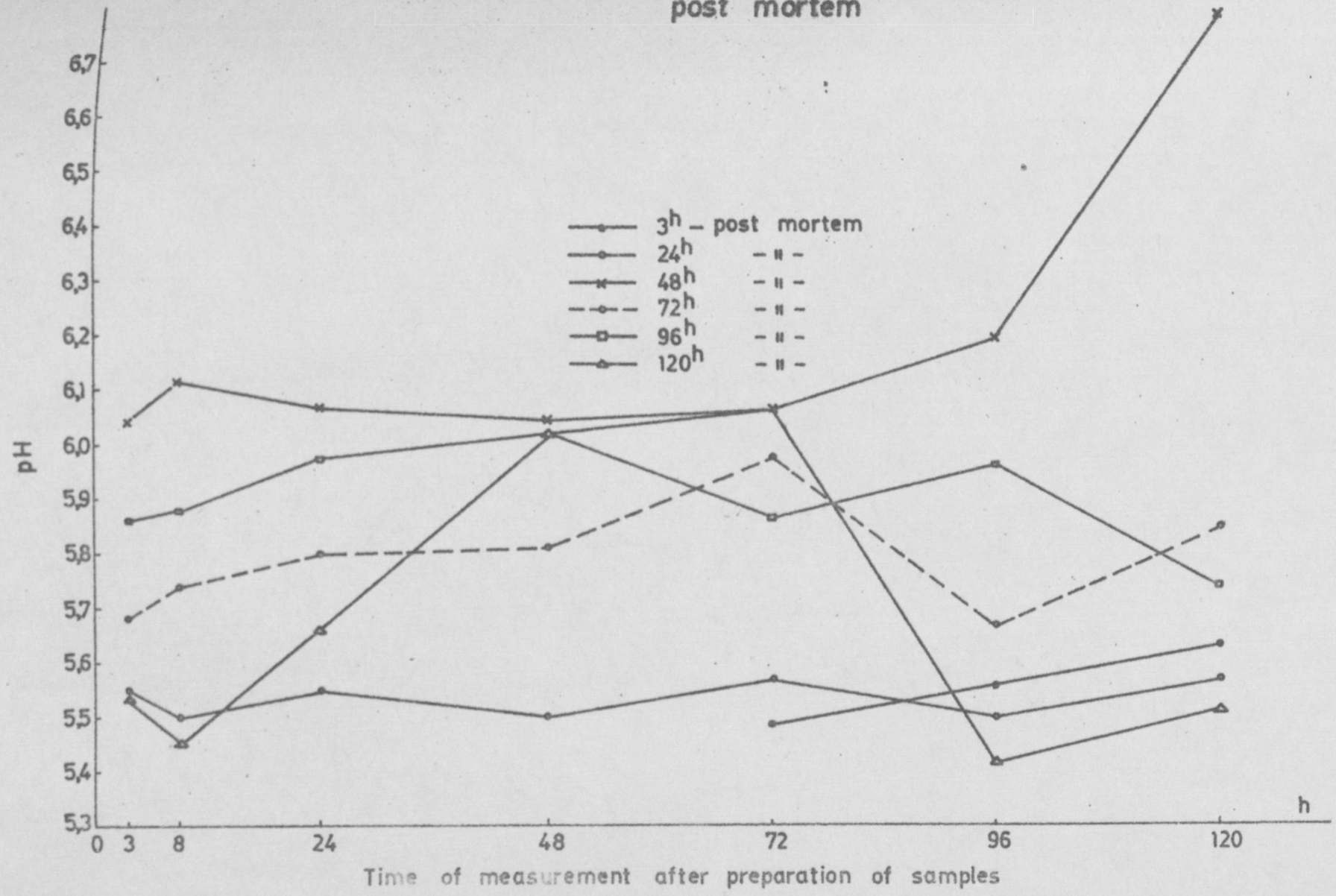

Fig. 4-4. pH of samples of m.L D prepared as VII variation 3,24,48,72,96 and 120 h post mortem

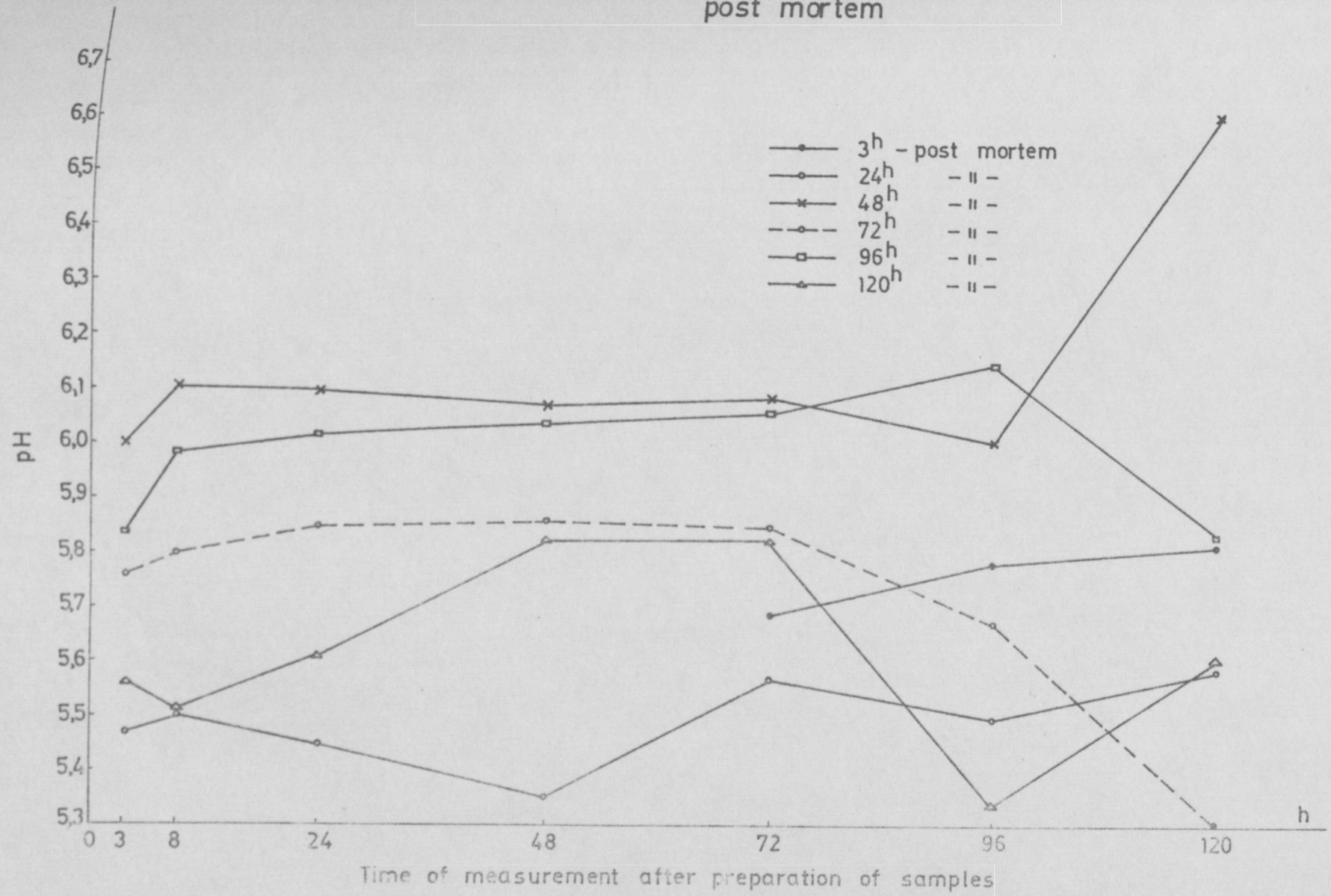

Fig. 5–5. pH of samples of m. L D prepared as X variation 3,24,48,72,96 and 120 h post mortem