## Feststellung des Nährweres in Nahrungsmitteln mit Hilfe der Hochleistungsflüssigkeits-chromatographie

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Eine Methode wurde entwickelt für die schnelle Bestimmung des Anteils der Skelettmuskulatur in der Nahrung über den 3-Methyl-Histidingehalt. Eine 5-minütige Elutionszeit bei Anwendung der Hochleistungsflüssigkeitschromatographie gab reproduzierbare und genaue Resultate.

Diese Methode kann auch gebraucht werden um die Skelettmuskel "turnover" Rate zu bestimmen und damit den Nährwert im Menschen, durch Bestimmung des 3-Methyl-Histidingehaltes im Urin. Der wasserlösliche Vitamingehalt von Fleischprodukten kann auch bestimmt werden mit der Hochleistungsflüssigkeitschromatographie durch 15-minütige Elutionszeit.Resultate über den Vitamingehalt bei Schweinen mit verschiedenen Methoden werden dargestellt.Eine Analyse handelsüblicher"Fleischpies" zeigte eine große Variation im Fleischgehalt, die nicht mit dem Proteingehalt korreliert ist. Die Ergebnisse werden im Hinblick auf die Gesetzgebung diskutiert.

## Determination of the Meat Content and Nutrition Value of Foods by High Performance Liquid Chromatography

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A method has been developed to rapidly determine the proportion of skeletal muscle in foods by their 3-methyl-histidine contents. A five minute elution time using high performance liquid chromatography gave reproducible and accurate results.

This method can also be used to determine the skeletal muscle turnover rates and hence nutritional status in humans by measurement of 3-methyl-histidine levels in urine.

The water-soluble vitamin content of meat products can be determined also by high performance liquid chromatography using a 15 minute elution time and the results of different processing conditions on vitamin content of pork are presented.

An analysis of commercial meat pies indicated that there was a wide variation in their meat content and this was unrelated to their protein content.

The results are discussed in relation to food regulations.

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## Détermination, par Chromatographie Liquide à Haute Performance, de la Teneur en Viande et de la Valeur Nutritionnelle des Aliments

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Une méthode a été développée pour déterminer rapidement la proportion de muscle squelettique dans les aliments par leur contenu de 3. Methyl-histidine.

En utilisant cette méthode de chromatographie liquide à haute performance pendant cinq minutes d'élution on obtient des résultats exacts et reproductibles.

Cette méthode peut également être utlisée pour déterminer les proportions du muscle squelettique et du statut nutritionnel chez l'homme par mesurage dans l'urine, des niveaux de 3. Methyl-histidine.

Le taux de vitamine soluble des viandes peut être déterminé également par chromatographie liquide à haute performance en utilisant une élution de 15 minutes et less résultats des différentes conditions de traitement sur le contenu en vitamine de la viande de porc, sont présentés.

Une analyse effectuée sur les patés à la viande vendus dans le commerce a indiqué qu'il y avait une grande variation dans leur contenu en viande et que cela était sans rapport avec leur taux de proteine.

Les résultats sont débattus relativement à la législation sur les aliments.

## Определение количества мускульного мяса и его питательных качеств в пищевых продуктах при помощи высокопроизводительной жидкостной хроматографии.

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В настоящее время разработан метод для быстрого определения количества мускульного мяса в пищевых продуктах путем измерения количества 3-метил-гистидина в продуктах. Измерение производится при помощи высокопроизводительного жидкостного хроматографа. Процесс измерения длится пять минут и дает точные и повторимые результаты.
Этим же способом, измеряя количество 3-метил-гистидина в моче, определяется скорость прохождения мяса через пищеварительную систему и, следовательно, питательные качества мяса.
Содержание растворимых в воде витаминов в мясных продуктах также определяется способом жидкостной хроматографии. Процесс этот длится пятнадцать минут.
Приложенные таблицы дают содержание растворимых в воде витаминов в свинном мясе в результате различных способов приготовления.
Анализ "мит-паев" (нечто вроде пирожков, в большом ходу в Австралии) показал, что количество мяса в отдельных "мит-паях" варьирует в очень обширных границах, и не имеет никакого отношения к содержанию протеинов в "мит-пае".
Результаты этих исследовании будут обсуждаться в связи с законодательствами в области пищевой промышленности.

# Determination of the meat content and nutritional value of foods by high performance liquid chromatography

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Meat contributes to the average Western diet a large percentage of protein (28%), fat (29%), calcium (2%), iron (29%), vitamin A (25%), thiamin (17%), roboflavin (20%) and nicotine acid (36%) (1).

In recent years there has been an increase in the use of non-meat proteins to replace meat in foods such as fresh sausages and comminuted meat products. Apart from breaching food regulations in some countries the reduction in water soluble vitamins and minerals is of concern to nutritionists (1,2).

Collagen derived from cheaper cuts of meat and connective tissue of animals has a biological value of zero since it does not contain the essential amino acids tryptophan and cystine and the nutritional values of the protein of sausages has been negatively correlated with the amounts of collagen and positively correlated with the amounts of skeletal muscle present (5,6). The hydroxyproline content of meat products is a measure of their collagen content and this analysis has been automated on an autoanalyser (6).

The amino acid 3-methyl histidine only occurs in myofibrillar skeletal protein of animals and the determination of meat in foods has been quantitatively successful using 3-methyl histidine analysis (3). The method has been adapted to high performance liquid chromatography and analysis times have been reduced from 7 hours to 10 minutes. The accuracy of the analysis has also been increased several fold by this method which involved reverse phase chromatography, ultraviolet detections followed by electronic integration of peak areas (4).

The protein, 3-methyl histidine and the calculated skeletal muscle content of the "meat" content portion of commercial samples of meat pies and hamburger patties are shown in Table 1. There was a wide variation in the values and no significant correlation between the protein content of the products and their meat content ($r = 0.26$, $P > 0.05$) as calculated from their 3-methyl histidine content. The meat pie, sample 4, contained the highest amount of protein but the lowest calculated amount of skeletal muscle meat

Table 1

Meat Products

| Sample | Protein (g%) | 3-methyl histidine (g/gN) | "Calculated" Skeletal Muscle Meat (g/100g) |
|---|---|---|---|
| *longissimus dorsi* | | | |
| Beef | 25.7 | 5.4 | 100 |
| Lamb | 23.4 | 5.2 | 100 |
| Meat Pie | | | |
| 1 | 8.2 | 4.1 | 76 |
| 2 | 4.8 | 2.3 | 43 |
| 3 | 5.3 | 4.5 | 83 |
| 4 | 11.5 | 1.9 | 35 |
| 5 | 6.2 | 3.4 | 63 |
| 6 | 6.7 | 5.2 | 96 |
| 7 | 5.7 | 4.5 | 83 |
| 8 | 6.1 | 3.4 | 63 |
| 9 | 6.5 | 3.8 | 70 |
| Hamburgers | | | |
| 1 | 2.5 | 1.3 | 24 |
| 2 | 2.3 | 1.1 | 20 |
| 3 | 2.8 | 1.6 | 30 |
| Standard error of mean | 0.08 | 0.06 | 0.83 |

High performance liquid chromatography has been used to study the nutrient content of meat and the effects of processing on the retention of nutrients in meat products.

Figures 1 and 2 show the chromatographic analysis of available lysine (dinitrophenyl derivative) and the water soluble vitamin respectively. Pork loin chops (*longissimus dorsi*) were cooked using conventional electric and microwave ovens (2450 megahertz) to internal temperatures of 80°C. The results are shown in Table 2.

The iron content of the meat was also measured by atomic absorption spectrophotometry and the results indicated that there was no significant difference between iron or niacin retention for the two methods of cooking. These nutrients indicate losses due to leaching during cooking and most of the iron and niacin were recovered in the drippings. The available lysine content indicates losses due to thermal chemical reactions and there was no significant difference between either method of cooking.

Table 2

Effects of cooking on nutrients in Pork Chops (*longissimus dorsi*)

| | Available lysine (g/16gN) | Iron ($\mu$g/g) | Niacin ($\mu$g/g) |
|---|---|---|---|
| Raw | 10.9 | 5.8 | 57.1 |
| Cooked * (electric oven) | 9.7 | 3.9 | 38.7 |
| Cooked * (microwave oven) | 9.9 | 4.1 | 36.6 |
| Mean cooking loss (%) | 10.1 | 31.0 | 34.1 |

* Cooking end point corresponds to an internal temperature of 80°C.

It is of importance to note that hydroxyproline measurements indicate the amount of connective tissue in meat products and do not give any indication that non-meat proteins (e.g. soybean, casein) may have been used in their manufacture, whereas 3-methyl histidine values indicate the true skeletal muscle meat content of meat products.

Developments in the field of high performance liquid chromatography have simplified the rapid and accurate determination of the meat content and water soluble vitamins in meat products so that in the future consumers should be assured of wholesome products.

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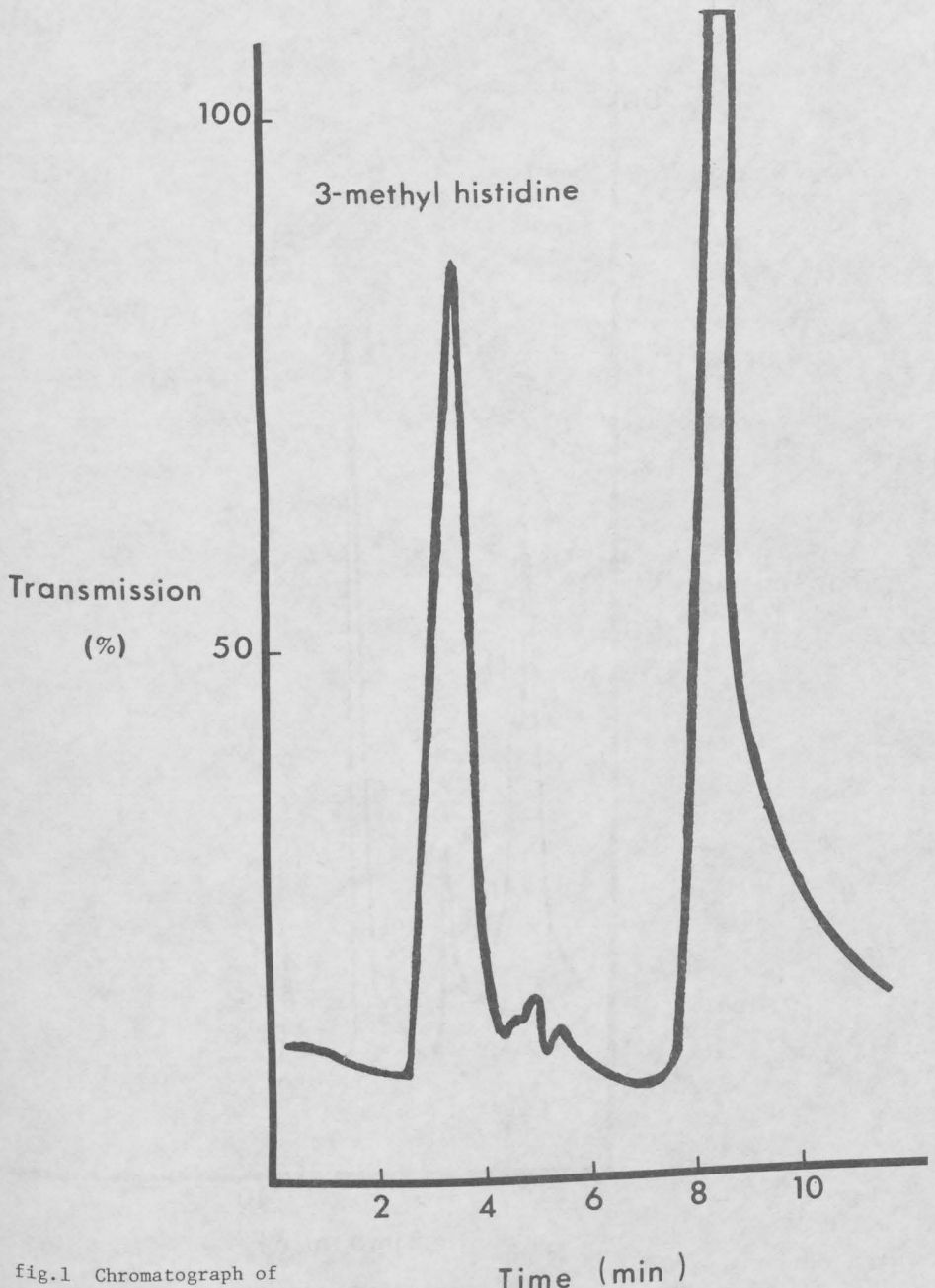


fig.1 Chromatograph of 3-methyl histidine

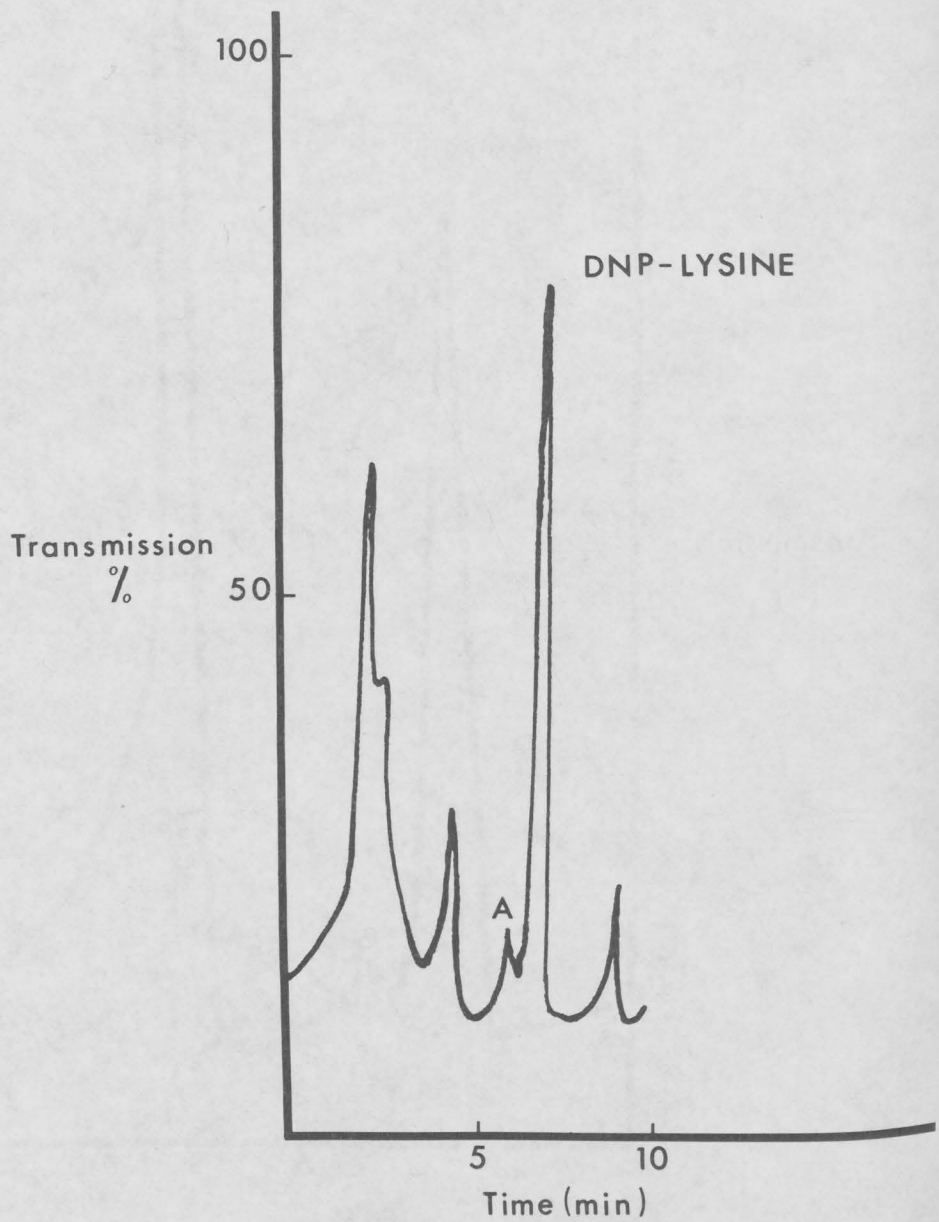


fig.2 Chromatograph of dinitro phenyl
derivative of lysine (available lysine)