Modifikation des biologischen Nährwertes von Fleischeiweiß Ersatzstoffen

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Der biologische Nährwert von Eiweissfleischwechsler ist meistens durch zu niedrigen Genalt an Schwefelaminosäuren begrenzt. Die Zugabe der sich im Unterschuss befindlichen Aminosäuren den biologischen Nährwert des Präparates verbessern kann. Gewöhnlich diese Zugabe von synthetischen Schwefelaminosäuren von dem ökonomischen Standpunkte micht gegründet ist. Deshalb hat man beschlossen das Hydrolysat des Keratinrohstoffes, d.h. die Schweinborste, zu verwenden.

Anfangs hat man mittels dieses Hydrolysates das Natriumkaseinat bereichert. Für die erhalten Präparate werden die chemischen Indexe /CS und EAA-Indexe/ berechnet, sowie andere Indexe, wie u.B. NPU, bestimmt. Im Falle der Mischungen, in denen ca 20% der Gesamtmenge von Aminosäuren aus dem Schweinborstenhydrolysat stammte, hat man den Wart von NPU = 81 bekommen, im Vergleich mit 65-70 NPU-Wertes der handelsüblichen Präparate des Natriumkaseinates, bekommen.

Zu den minderwertigsten Eiweissen gehört das Kollagen /in Rücksicht auf den Nährwert/, doch aus dem technologischen Standpunkte ist es wertvoll. In diesem Falle entstand die Notwendigkeit der Zugabe, unabhänging von Schweinborstenhydrolysat, von anderen Eiweiss, das reich an Tryptophan und Lysin ist, d.h. das Rindblutserum.
Bei verwendung von Symplexmethoden wurden die Abhängigkeiten zwischen dem Anteil der allen drei Komponenten und dem biologischen Wert der erhaltenen Mischungen festgestellt. Es wurde auch die Herstellungsmethode des Kollagenpräparates bearbeitet und dabai wurden gute technologische Eigenschaften, sowie relativ hoher biologischer Wert dieses Präparates festgestellt /NPU = 53, BV = 54, NPR = 3,2 und PRE = 50/.

Modification of biological value of meat protein substitutes.

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The biological value of meat protein substitutes is generally reduced by the lack of sulphur amino acids and it can be increased by the addition of these amino acids. The addition of these amino acids in the form of synthetic products is frequently ineffective from the economic point of view. Therefore it was decided to use the keratin hydrolysates /such as, for instance, the bristle hydrolysates/.

At first these hydrolysates were used to enrich sodium caseinate. The values of the chamical score /CS/ and essential amino acids index /EAA/ were calculated for these preparations as well as some other indexes /for example: NPU/. If about 20 per cent of the total amount of amino acids in model preparations are derived from the bristle hydrolysate we have established that these preparations have better biological value /NPU = 83/ than any commercial preparation of sodium caseinate /NPU = 65-70/.

As far as the biological value of collagen is concerned it is nearly useless. On the other hand it proves valuable from the point of view of its technological properties. In this case it was necessary to add the bovine blood plasma /rich in tryptophane and lysine/ as well as bristle hydrolysate. The correlation between the participation of these proteins and the biological values of the model preparations was established by means of the simplex method. The method of manufacturing collagen's proteins preparations possesing good technological properties and a high biological value /NPU = 53, BV = 54, NPR = 3,2 and PRE = 50/ was worked out.

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Modification biologique des valeurs alimentaires des échangeurs albuminiques de la viande.

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Dans la plupart des cas la valeur, biologique des échangeurs albuminiques de la viande est bornés par la teneur trop basse des aminoacides sulfuriques. On pent améliorer la valour biologique de la préparation par addition des aminoacides, dont la quantité est insuffisante. D´habitude l´addition des synthétiques aminoacides sulfuriques n´est pas motivée de la part économique et c´est alors qu´on a décidé, d´utiliser l´hydrolisat de kératine, c´est-a - dire la soie du porc.

Au commencement on a enrichi le caséinianate de sodium par cet hydrolisat. On a calculé pour ces préparations obtenues les indices chimiques /CS et EAA-index/ et on a ubduqué autores indices comme p.ex. NPU. Dans le cas des mélanges, dans lesquels 20% environ de la quantité générale provenait de l´hydrolisat de soie du porc, on a obtenu la valeur de NPU =81, en comparison de NPU = 65-70 concernant les préparations commerciales du caséinianate de sodium.

S´il s´agit de la valeur des albumines /à l´égard de la valeur biologique/ - c´est collagène qui appartient aux albumines se coractérisant par a moindre valeur. Il est pourtant de valeur sous l´aspect technologique. Il fallait, outre l´hydrolisat de la soie du porc, ajouter d´autre albumine riche en tryptophane et en lysine, c´est-a-dire le sérum du sang bestial. On utilisant les méthodes symplexes - on a fixé les corrélations entre la participation de tous les trois composants et la valeur biologique des mélanges obtenus. On a élaboré aussi la méthode d´obtention d´une préparations albuminique à la base de collagène, qui sa caractérise par les bons paramètres technologiques et par les valeur biologiques relativement hautes /NPU = 53, BV = 54, NPR = 3,2 et PRE = 50/.

Модификация биологической питательной ценности белковых заменителей мяса

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В большинстве случаев биологическое значение белковых заменителей мяса ограничено слишком низским содержанием серных аминокислот.Добавлением аминокислот,которых нехватает, можно улучшить биологическую ценность препарата.Добавка синтетических серных аминокислот обычно экономически необоснована.Поэтому решено применить для этой цели гидролизат кератинного сырья -щетины.Вначале гидролизатом обогащено казеинат натрия. Для полученных препаратов вычислено показатели: CS и EAA-индекс и определено другие показатели например NPU. В случае смесей, в которых около 20% общего количества аминокислот происходило из гидролизата щетины, получено значение NPU = 8I по сравнению к NPU равне 65-70 для торговых препаратов казеината натрия.Одним из наименее ценных белков (с точки зрения биологической ценности)является коллаген. Ценность его все-таки представляется с технологической точки зрения.В этом случае существует необходимость добавления кроме гидролизата-щетины другого белка богатого в триптофан и лизин- плазмы крови скота. При применении симплексных методов обнаружено зависимости между долями всех этих компонентов и биологической ценностью полученных смесей.Разработано также метод получения колагенного белкового препарата с хорошими технологическими свойствами и относительно высокой биологической ценностью (NPU= 53, BV = 54, NPR = 3,2 и PRE = 50).

Modification of biological value of meat protein substitutes

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Recently some protein preparations are used in meat products for the replecement of meat in meat products. Therefore the meat protein substitutes should have their properties not worse than meat. It is true for their biological value, as well.

The biological value of protein preparations depends on many factors and one of the most importent of them is the amino acid composition of these preparations. Until now, the majority of works concerning the field we are interested in, were connected with the problem of the correlation between the biological value of protein preparations and their composition and the influence technological procedures on this composition.

It was establish that the biological value of meat proteins is usually higher than the values determined for non-meat protein preparations. The majority these preparations contain disproportionate amounts of certain amino acids and their biological value can be increased by adding these amino acids or other protein preparations which are very rich in these amino acids.

The biological value of meat protein substitutes is generally reduced by the lack of sulphur amino acids. From the economic point of view, the addition of these amino acids in the form of synthetic products is frequently ineffective. Therefore it was decided to use keratin hydrolisates /e.g. the bristle hydrolysates/.

The effect of the preliminary research was the selection the bristle hydrolysate /BH/ whose composition is shown in Table 1.

At first this hydrolysate was used to enrich sodium caseinate. Using a special procedure it was possible to obtain some model preparations whose compositions are described in the following equation:

$$X_c + X_H = 1 \qquad 0 \leq X_c \quad \text{and} \quad 0 \leq X_H$$

where:

X_c = contribution of amino acids from sodium caseinate to a model preparation

X_H = contribution of amino acids from the bristle hydrolysate to a model preparation

The values of the chemical score /CS/ and the essential amino acid index /EAA/ were calculated for these preparations and the result of these calculations is shown in Figure 1.

The presented curves can be described by parabolic equations with one independent variable: $X_c / X_H = 1-X_c /$

$$Y_{cs} = -0{,}002126 + 1{,}106715X_c - 1{,}32427X_c^2 + 3{,}25505X_c^3 - 2{,}502914X_c^4 \qquad R^2 = 0{,}9986$$

and $$Y_{EAA} = 0{,}00320 + 10{,}88909X_c - 64{,}70527X_c^2 + 189{,}7128X_c^3 - 285{,}1395X_c^4 + 211{,}432X_c^5 - 61{,}39594X_c^6$$

$$R^2 = 0{,}9972$$

The extremes of these functions were found by means of calculating their derivatives:

$Y_{cs\text{-}max} = 0{,}678$ for $X_c = 0{,}817$ and $Y_{EAA\text{-}max} = 0{,}846$ for $X_c = 0{,}645$

It is evident now that the use of a part of amino acids derived from the bristle hydrolysate in more than 20 per cent of total amount of amino acids is superfluous.

It about 20 per cent of total amounts of amino acids in model preparations is derived from bristle hydrolysate it was established by means of nutritional methods that these preparations have better biological value /NPU = 83/ than any commercial preparation of sodium caseinate /NPU = 65-70/.

The same procedure can be used for any other protein preparation.

As far as biological value of collagen is concerned it is nearly useless. There is a lack of sulphur amino acids and tryptophan as well. Similarly, the content of other amino acids is not balanced. On the other hand, collagen preparations prove valuable from the point of view of their technological properties. In order to improve the nutritional properties of collagen preparations it was necessary to add the bovine blood plasma /rich in tryptophan and lysine/ as well as the bristle hydrolysate.

As a result of a special procedure a number of preparations having the following composition were obtained:

$$X_p + X_H + X_{col} = 1$$

$$0 \leq X_p \quad \text{and} \quad 0 \leq X_H \quad \text{and} \quad 0 \leq X_{col}$$

where:

X_P= contribution of amino acids from bovine blood plasma to a model preparation
X_H= contribution of amino acids from the bristle hydrolysate to a model preparation
X_{col}= contribution of amino acids from a collagen preparation to a model preparation

For these preparations the values of CS and EAA-index were calculated as a function of the participation of particular components.

The results of these calculations are shown in Figure 2 and 3. Since the sum of all components in these mixtures must be equal to 1, only two independent variables /e.g. X_p and X_H/ are taken for statistical analysis. It was assumed that the interdependence of the variable Y to variables X_p and X_H is described by a polynomial for two independent variables of not higher than the fifth degree. The coefficients of these regressions were calculated by means of the least square method. In the next step, the statistical non-significant elements /for significance level: $\alpha = 0,05$/ of these polynomials were eliminated. Multiple correlation coefficients were calculated for all the investigated regressions.

In the case of EAA-index the following equation was obtained:

$$Y = 0,0088 + 5,60788X_p - 28,45776X_p^2 + 67,47820X_p^3 + 5,85878X_p \cdot X_H -$$
$$- 10,29773X_p^2X_H - 2,60663X_pX_H^2 - 70,53309X_p^4 + 26,64993X_p^5 +$$
$$+ 5,85990X_p^4X_H + 6,53730X_p^3X_H^2$$

$$R^2 = 0,9884$$

And in the case of CS- index this equation was obtained:

$$Y = 0,00101 + 0,93937X_p + 2,57173X_p^2 - 13,50201X_p^3 + 3,10952X_p^2X_H - 0,54005X_pX_H^2 + 17,79632X_p^4 -$$
$$- 7,41769X_p^5 - 3,08619X_H^5 - 2,15834X_p^3X_H^2$$

$$R^2 = 0,9934$$

The analysis of all these equations indicates that both of the investigated indexes /being functions of all indenpendent variables: X_p, X_H and X_{col}/ attain their extremal values on the edge of the domain of these functions. It is true for $X_{col} = 0$.

Therefore the investigation of the extremal values of these functions is connected with the new restriction:

$$X_p + X_H = 1 \qquad 0 \leq X_p \quad \text{and} \quad 0 \leq X_H$$

This restriction reduces the former functions to equations with only one independent variable:
For EAA-index:

$$Y = 0,0033 + 11,1274X_p - 66,83097X_p^2 + 196,5304X_p^3 - 296,3115X_p^4 + 220,5954X_p^5 - 64,386X_p^6$$

and for CS index:

$$Y = 0,00089 + 1,1584X_p - 2,0133X_p^2 + 17,5779X_p^3 - 51,3293X_p^4 + 55,5399X_p^5 - 20,5538X_p^6$$

These functions have the following extremal values:

$$Y_{EAA\text{-}max} = 0,820 \qquad \text{for} \quad X_p = 0,622$$

and

$$Y_{cs\text{-}max} = 0,438 \qquad \text{for} \quad X_p = 0,536$$

As a result of all presented investigations it is obvious that the best biological value of model preparations is obtained in the case of the use of the mixture of blood plasma protein and bristle hydrolysate. Every addition of collagen preparation reduces the biological value of these preparations. This relation can be described by the regression in the form of a polynomial of the sixth degree. On the other hand collagen preparations are very usefull in improving the rheological properties of protein preparations. In order to make the composition of the new preparation optimal, its structural and sensoric properties along with its biological value should be considered. A number of investigations of the model preparations, and meat products containing these preparations were carried out.

The results of the determination of the biological value of some model preparations are shown in Table 2. For example, preparation No 3 has NPU value equals 52,7. It is a good result, comparable to values obtained for some soya preparations /e.g. Promine D/ but its price is significantly lower. The use of these preparations as meat protein substitutes /up to 15 per cent/ has not decreased the consumer quality of some model sausages.

The problem of the biological value of protein preparations is connected not only with their amino acid composition. The importance of other components such as vitamins and minerals which are constant meat components should not be underestimated. Nevertheless, the composition of amino acids of protein preparations is the most important problem in the optimalization of their biological value.

The described simplex method can be very usefull in the optimalization of the composition of meat protein substitutes.

Table 1

Percentage of essential amino acid content of the bristle hydrolysate

Amino acid	Total content of amino acid /%/
threonine	4,6
cystine	8,1
valine	5,2
methionine	3,1
isoleucine	2,8
leucine	8,7
tyrosine	2,7
phenylalanine	1,9
lysine	3,1

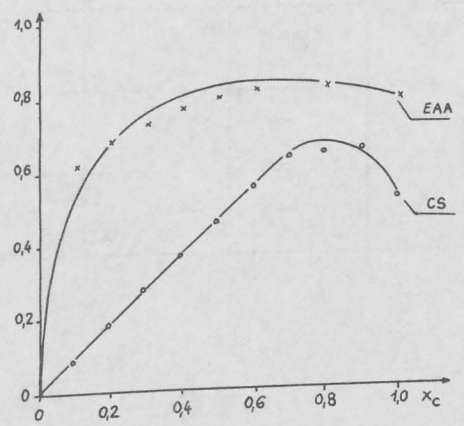

Fig. 1. CS and EAA-index values of combinations of sodium caseinate and the bristle hydrolysate

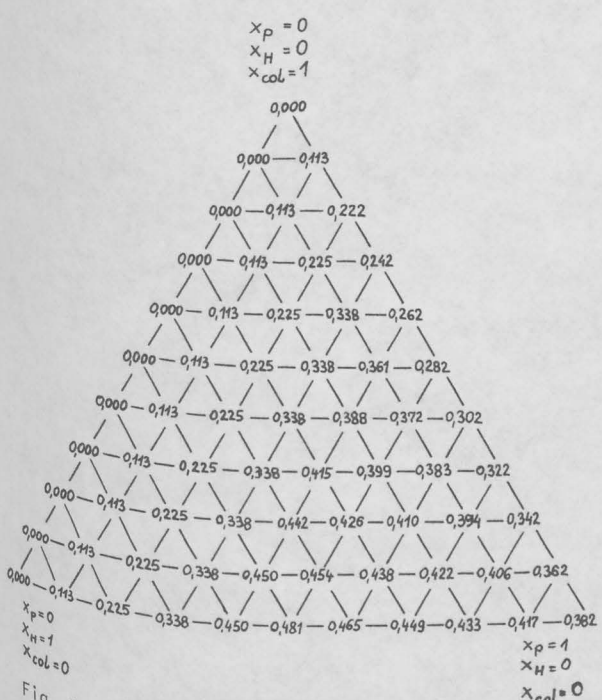

Fig. 2. Values of chemical score of combinations of collagen and blood plasma and the bristle hydrolysate

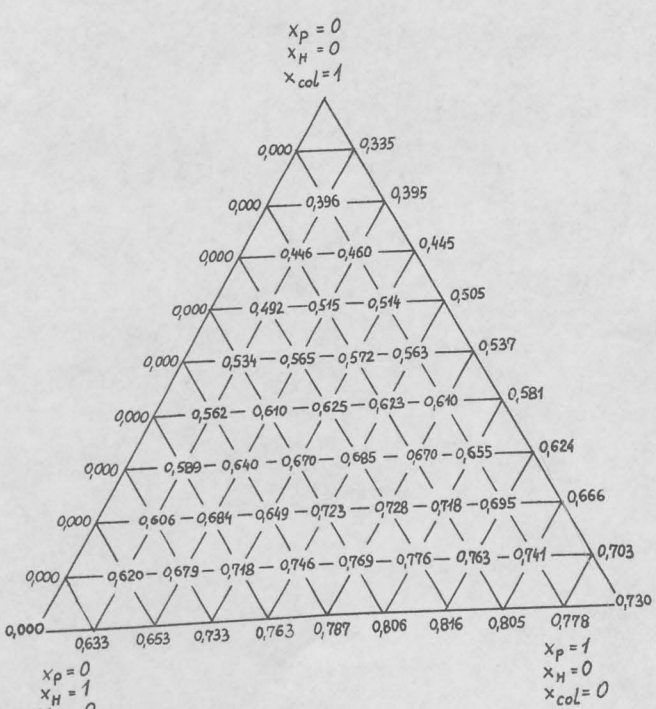

Fig. 3. Values of EAA-index of combinations of collagen and blood plasma and the bristle hydrolysate

Table 2

Nutritive values of some investigated preparations

composition of preparations			Net Protein Utilization /NPU/	Net Protein Ratio /NPR/	Protein Retention Efficiency /PRE/	Biological value /Bv/
X_p	X_H	X_{col}				
0,349	0,000	0,651	46,1	2,77	44,3	46,3
0,316	0,099	0,585	50,2	3,10	49,6	50,6
0,284	0,186	0,530	52,7	3,17	50,1	54,2