Egypt. J. Agric. Res., 73 (2), 1995.

EFFECT OF HEAT AND MOISTURE CONTENT OF MAIZE ON PROTEIN DIGESTIBTLITY BY TRYPSIN AND CHYMOTRYPSIN ENZYMES

S.M. MANSOUR, A.M. KASSEM And Y.Z. ABOELAZM

Food Technology Research Institute, Agricultural Research Centre, Giza, Egypt.

(Manuscript received 8 February 1993)

Abstract

Maize grains were tempered at the moisture content of 13%, 18% and 24% and heated to 108 °C, 150°C and 174 °Cfor 3.6 and 9 minutes. After removing the hull and the germs, the endosperm was digested by trypsin and chymotrypsin enzymes. The digestive rate was evaluated as the drop of PH, and the digestive coeffecient when measured as buffering capacity . The results indicated that the best condition to give a good protein digestibility was 18% moisture for 3 minutes heating at 175°C when trypsin enzyme was used, and 13% moisture for 6 minutes heating at 150°C when chymotrypsin enzyme was used.

INTRODUCTION

Food proteins can not be used by man unless they are broken down to small peptides and amino acids capable of being absorbed into the small intestinal buush border membrane covpable of being absorbed into the odes, et al., 1967). Protein digestion is initiated within the stomach by pepsin (Bergmann and Fruton, 1941), an

taken as the index of proteolysis enzymes. Trypsin induced the largest PH drop than chymotrypsin.

As it is clear from Fig1, at 13% moi-sture, and 3 minutes exposure, the activity of enzymes was indicated by the highest drop in PH values at 175°C than 108°C and 150°C.

In case of 6 minutes exposure (Fig 2), the drop of PH was highly pronounced at 150°C rather than at 150°C and 175°C . A t 9 minutes exposure (Fig 3), the activity of both enzymes showed the largest drop in PH at 175°C. This behavior may be due to the alteration in the nature of the peptide bond of treated flour proteins, thus leading to susceptibility to trypsin and chymotrypsin known to attack certain amino acids in the peptide chain. This might indicate variable binding sites available for the enzyme.

As the moisture level increased to 18% at 3 minutes exposure time, trypsin activity showed less decline in PH at 150°C than at 108°C and 175°C . In case of chymotrypsin, the highest drop of PH was noticed at 175°C compared with 108°C and 150°C. The two enzymes restored their activity when the exposure time increased to 6 and 9 minutes . This might be due to the interaction between protein and starch faction of the flour resulting in a complex compound which resists the enzyme action. Restoration of enzyme action after increasing the exposure time may prompt enzymes to attack the protein once more.

At the highest level of moisture content (24%) , and at 3 minutes exposure time, the enzymes activity had decreased at all temperatures . The enzyme activity was restored once more when the exposure time was increased to 6 minutes, especially at 150°C and 175°C. This could be due to the splitting of some secondary bonds thereby increasing protein enzyme complex formation.

The present work was extended to include treatments which gave the best digestibility (the highest decline of PH after 10 minutes). The selected treatments were subjected to digestion with both enzymes for 24 hours (Fig.4) Treatment of 18% moisture at 175°C for 3 minutes exposure time was the best for trypsin treatment. However, treatment of 13% moisture at 150°C for 8 minutes was more convenient for chymotrypsin enzyme.

The buffering capacity of these two treatments were studied (Table 1) . The buffering capacity increased as moisture content increased to 18% and 24%. This increase was obove 35% a matter indicating that the increase in moisture content

increases the effect of heat in flour protein, thus releasing amino acids from some sections of the peptide chain into the flour. This might explain the effect of different temperatures on enzyme activity where thermal effect on the conformation and structure of protein interferes with proteolysis of trypsin and chymotrypsin.

Finally, it could be concluded that the peptide bonds of heat aggregated proteins were shown to be more susceptible to trypsin and chymotrypsin attack than those of untreated proteins. It was also evident that the effect of high moisture content of the treated flour, especially at 24% gave the same effect.

It could be therefore recommended that the best conditions for the industrial use of corn flour from the view point of protein digestibility are 18% moisture content for 3 minutes heating at 175°C for trypsin enzyme, and 13% moisture content for 6 minutes at 150°C for chymotrypsin enzyme.

Table 1. Effect of heat processing and moisture content on buffering capacities of maize endosperm.

Heat treatment		Moisture Content		
Time	C	13%	18%	24%
3	108	5.50	5.55	4.70
	150	4.80	8.25	8.85
	175	6.90	6.55	9.90
6	108	5.15	7.05	7.65
	150	4.45	9.10	8.00
	175	6.05	7.40	7.55
9	108	7.70	7.65	9.50
	150	5.95	7.45	9.10
	175	5.15	8.00	7.45

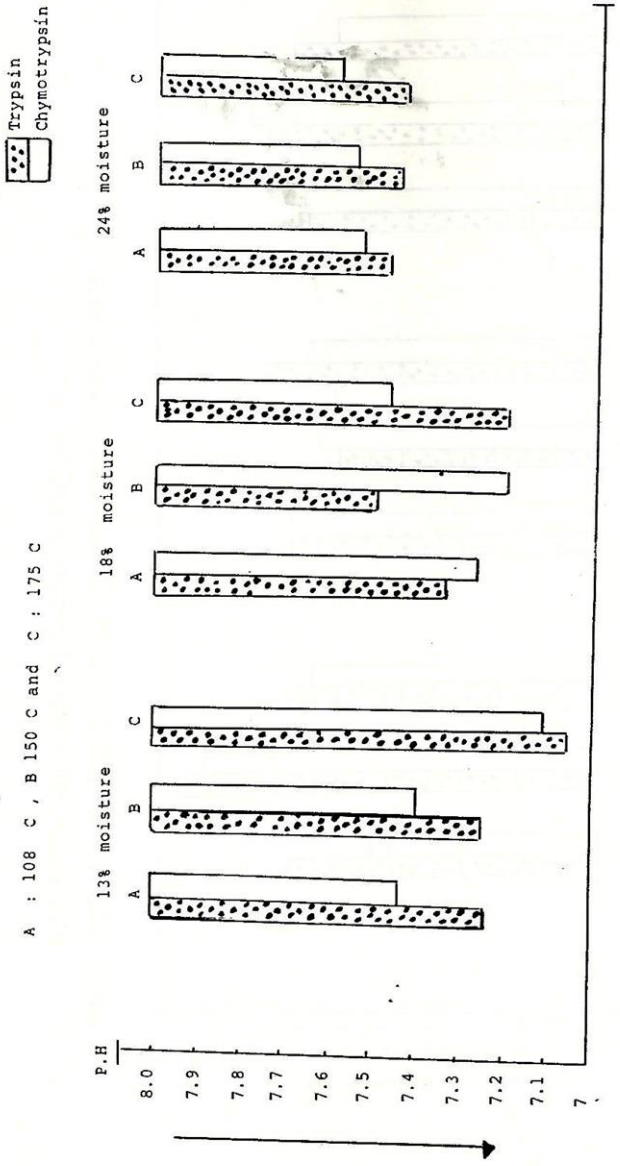

Fig. 1. Effect of thermal processing for 3 minutes and moisture content on PH drop after digestion with trypsin and chymotrypsin enzymes.

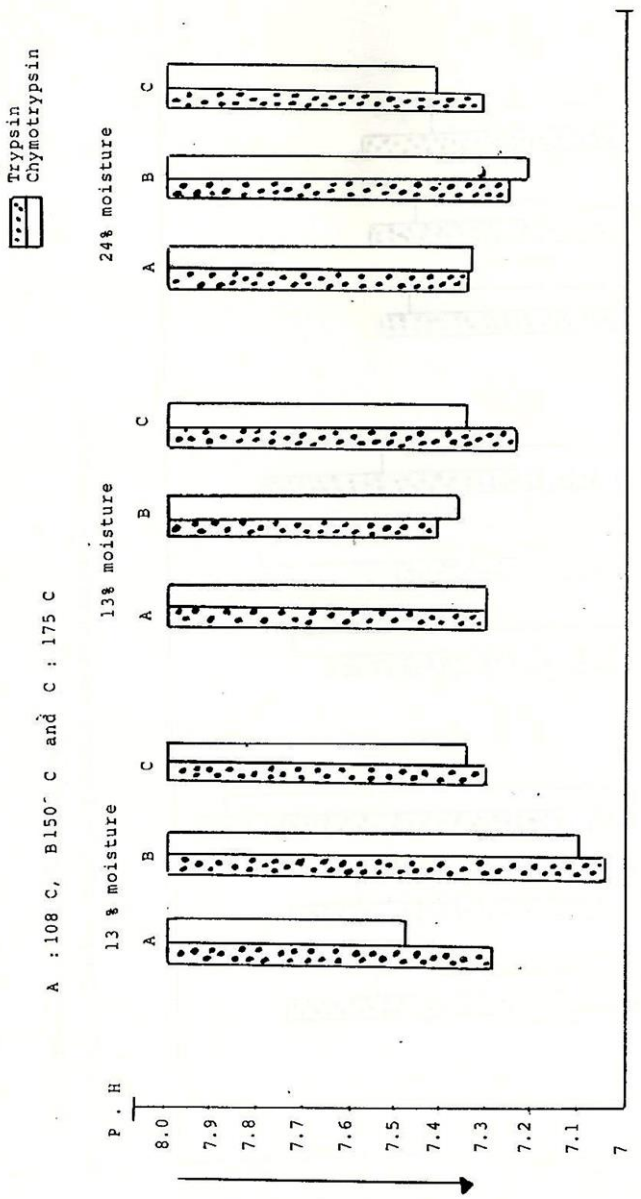

Fig. 2. Effect of thermal processing for 6 minutes and moisture content on PH drop after digestion with trypsin and chymotrypsin enzymes.

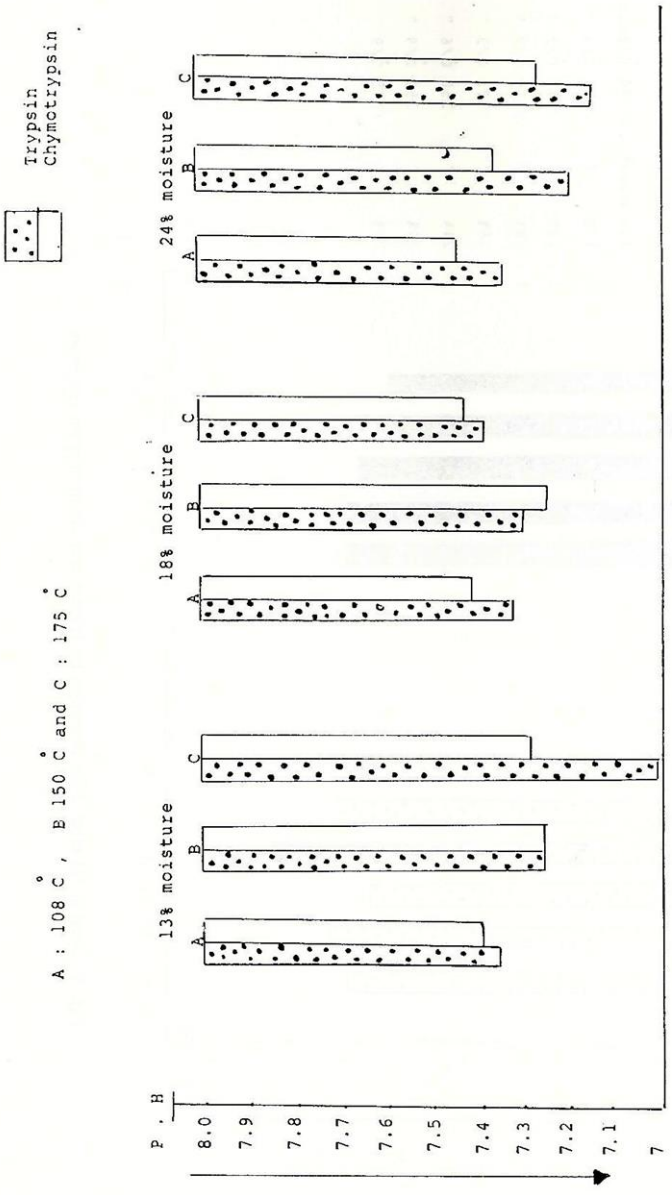

Fig. 3. Effect of thermal processing for 9 minutes and moisture content on PH drop after digestion with trypsin and chymotrypsin enzymes.

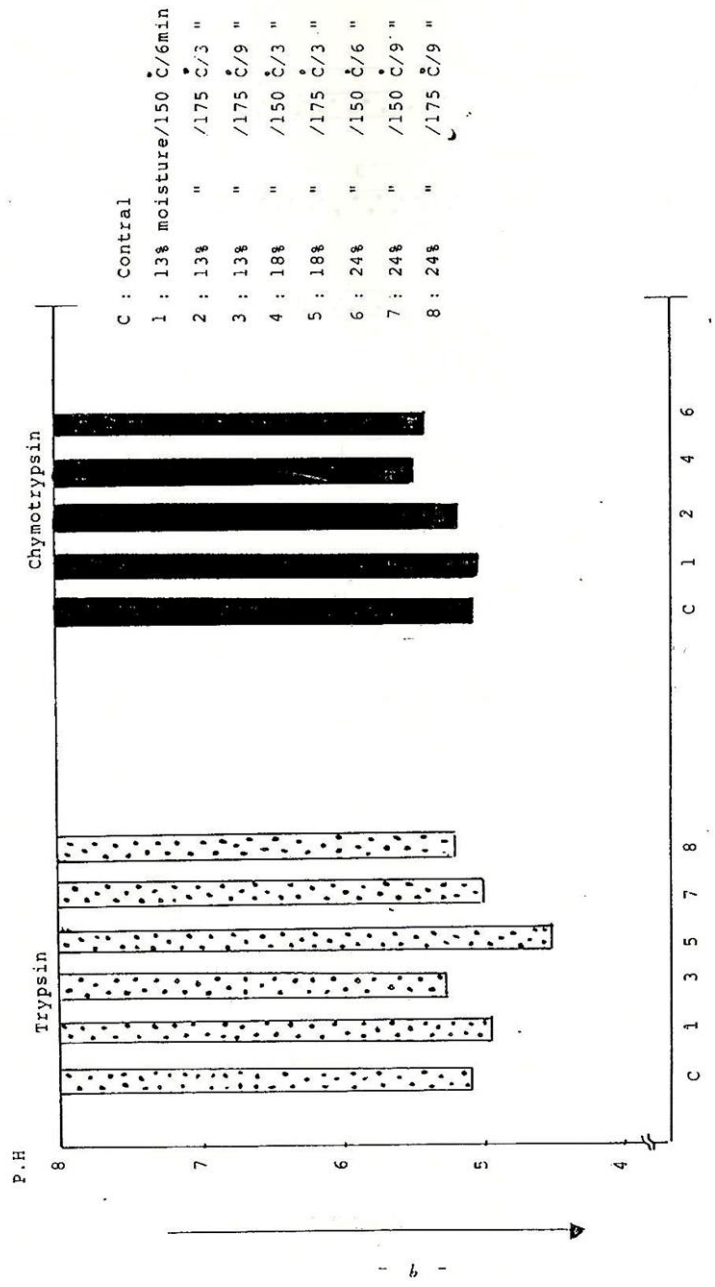

Fig. 4 . Drop in PH after 24 h digestion by trypsin and chymotrypsin enzymes.

تأثير التسخين ودرجة الرطوبة على معدلات هضم بروتين الذرة بواسطة انزيمات التربسين والكيموتربسين

سعيد محمد منصور ، احمد مراد قاسم ، يوسف زكى ابو العزم

قسم بحوث تكنولوچيا الاغذية - مركز البحوث الزراعية . الجيزة .

في هذه الدراسة تم رفع رطوبة الذرة الشامية الي ١٣٪ ، ١٨٪ ، ٢٤٪ وتعريضها لدرجات حرارة ١٠٨م° ، ١٥٠م° ، ١٧٤م° . وذلك لفترات زمنية ٩،٦،٣ دقيقة. ثم فصل القشرة والجنين وتقدير معدلات هضم بروتين الاندوسبوم بواسطة انزيمات التربسين والكيموتربسين كل دقيقة لمدة ١٠ دقائق وبعد ٢٤ ساعة كما قدرت الـ buffering capacities لجميع المعاملات للتأكد من قيم معدلات هضم البروتين التحصيل عليها . وقد اظهرت النتائج المتحصل عليها ان احسن المعاملات التي تعطي أفضل معامل هضم بروتين هي :

١٨ ٪ رطوبة / ٣ق / ١٧٥م° عند استخدام إنزيم.

١٣٪ رطوبة / ٦ق / ١٥٠م° عند استخدام إنزيم.