STABILITY OF PREFORMED EMULSIONS USING NON MEAT PROTEINS AND THEIR USE IN MEAT PRODUCTS

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SUMMARY

The main objective of this study was to determine the effect of non meat proteins on the stability of preformed pork fat emulsions and to explore their application in meat products. The following proteins were studied in detail: High Viscosity Caseinate, Low Viscosity Caseinate, Soya Isolate, Total Milk Proteins and Whey Protein Concentrate. Preformed fat emulsions were manufactured (5:5:1 and 8:8:1) and their stability was tested under various cooking conditions. The hardness and sliceability of the emulsions were also determined. It could be shown that the emulsion stability of performed fat emulsions depended on the type and concentration of protein, chopping time and method of cooking. The stable fat emulsions obtained were then incorporated into different fresh pork sausages and their influence on product quality was determined. The influence of whey protein concentrates on water binding, meat binding and the overall quality in cooked hams was evaluated.

Introduction

Proteins are important nutritional, structural and functional components of traditional foods. Protein ingredients are used in processed and fabricated foods and must possess certain desired functional properties. These functional properties required vary with the particular food system. In meat systems water binding, fat binding, solubility, viscosity, surface activity and gelation are the most important properties in determining the usefulness of a protein and its impact on the final product quality (De Witt, 1984; Endres and Monagle, 1987; Schutt, 1976)
In this study the functional properties of different protein ingredients are compared in model systems and in pilot scale trials for different meat products.

Material and Methods

Preformed Emulsion Stability
The following ***proteins*** were used: High Viscosity caseinate 1, EM-HV (HVC1), 85% protein, DMV Veghel, Holland; Medium Viscosity Caseinate 2, EM-8 (HVC2), 85% protein, DMV Veghel, Holland; Low Viscosity Caseinate 3, EM-6 (LVC3), 85% protein DMV Veghel, Holland; Whey Protein Concentrate, (WPC), 70% protein, Carbery Milk Products; Whey Protein Concentrate, (WPC), 35% protein, Dairy Gold; Total Milk Protein, (TMP), 85 % protein, Teagasc,Moorepark, Fermoy; Soya Protein Isolate 500E, (SI) 86% protein, Ralston purina; Vital Wheat Gluten, (VWG) 73 % protein, Wheat Industries.

Preformed emulsions were prepared in a two speed (1,300 and 3,600 rev/min) bowl chopper using 5 parts pork back fat plus 5 parts water plus 1 part protein (5;5;1 or 9% protein) or 8 parts pork back fat plus 8 parts water plus 1 part protein (8;8;1 or 6% protein). The preformed emulsions were cooked in 5 oz cans using three heat treatments; Pasteurisation (72°C), sterilisation (121°C x 30 min) or frying (171 C x 10 min) and emulsion stability was measured using fat loss as an indicator. The method used was a modification of the procedure of Park and Lewis (1976).

Viscosity was measured using a Brookfield Synchro-Lectric viscometer (ModelRVT, Stoughton, Massachusetts). The readings were taken after 30 s shearing at a spindle speed of 100 rpm.

Gel Strength and Emulsion Firmness were measured, at 15°C using a flat stainless steel probe (1.2 cm diameter) attached to an Instron Universal Testing Machine (Model TM-M, High Wycombe, Bucks, England), as the force required to drive the metal probe into the gel to a depth of 1 cm at a speed of 3 cm/min.

Sliceability was measured at 15°C as the force required to cut, with a taut metal wire (0.6 mm) diameters, into the emulsion to a depth of 1 cm at a speed of 3 cm/min, using the Instron. The data reported are results from 10 seperate determinations.

Cooked Ham and Fresh Pork Sausage Production

Cooked ham production: 50 kg batches of boneless pork legs were injected with brine at a 20% level to give residual of 3% salt, 100 ppm nitrite, 0 or 0.4% phosphate and 2.5 to 4 % test protein powder. They were massaged and cooked to a core temperature of 70°C.

Water-Holding Capacity was determined according to Grau and Hamm (1957).

Fresh pork sausage production: 5kg batches of sausage mix were prepared from pork lean (90 V/L), pork back fat, seasoning and test protein powders at 5% and 10% additions and stuffed into collagen casings.

The protein powders tested were whey protein concentrates containing 35 % (normal and high gel) or 75% protein, egg albumin and soya isolate containing 90% protein. Lactose at 4% residual was also tested.

Results and Discussions

Preformed Fat Emulsions

Evaluation of the viscous behaviour of proteins is important relative to their application in meat systems. In this study the viscosity of several protein ingredients was tested. Results show that soya isolate (SI) at all protein concentrations was more viscous than high and low viscosity caseinates. The whey proteins, which are highly soluble but non swelling demonstrated the lowest viscosity (data not shown).

The capacity to form gels under practical conditions is an important functional property of many food proteins. In this study gel formation was greatly influenced by protein concentration and heat treatment. The WPC when used at 9% and 15% protein did not gel when heat treated at 20°C for 15 min, whereas, SI produced self supporting gels at the same protein concentrations (Table 1). However caseinates even at 15 % protein did not produce a stable gel but rather a self supporting paste under the same conditions. When heat was applied at 80°C x 15 min, the WPC gave a higher gel strength than SI and TMP. The ability of whey proteins to form gels on heating is a very desirable property especially when they are used in liver patés and meat spreads. In these products gels of different consistencies can be obtained by manipulating the type of WPC and the conditions of manufacturing.

Emulsion stability under varying heat treatments is an important test to evaluate the quality of proteins and their potential application in meat products. In this study emulsion stability of preformed fat emulsions was carried out using proteins as emulsifying agents at 6 % (8:8:1) and 9% (5:5:1) added protein. An emulsion was considered to be stable if fat losses were less than 2 % of the added fat. It was shown that fat losses depended on the type of protein, method of cooking and chopping time.

Under pasteurisation conditions all 5:5:1 emulsions were stable with the exception of the emulsion containing VWG. The only protein which produced a stable 8:8:1 emulsion under pasteurisation conditions was HVC1 (Table 2). Under sterilisation conditions 5:5:1 emulsions containingWPC, SI, HVC1 and HVC3 were stable. Using the same conditions SI formed the only stable 8:8:1 emulsion. On frying all emulsions collapsed except the one containing SI (Table 2). It has been reported by Parker & Lewis (1976) that the stability of preformed fat emulsions is affected by the quantity of free fat liberated during the chopping process which in turn has to be re-emulsified in the soluble protein fraction.

The moisture losses obtained are similar in trends to fat losses (Table 3). The heat treatment applied in such tests should reflect the cooking process, which is normally used for the product the protein will be added to.

Firmness and sliceability were used to measure the ability of proteins, in preformed fat emulsions, to give self supporting structures. The SI and HVCI protein produced the most firm and stable emulsions at the 5:5:1 ratio (data not shown)

Cooked Ham Trials

The functional requirements in low fat cooked meat systems are primarily water binding and meat binding. In this study it was shown that increasing residual powder levels resulted in higher cook yields for both 35%

(Table 4) and 75% (data not shown) WPC's. The presence of phosphate, had a positive effect (upto 14%) in increasing cook yield particularly at low residual powder levels. Water holding capacity showed similar trends.

Comparing powders at 3.5 % residual, the WPC (75 %) showed the greatest increase in cook yield followed by SI and egg albumin (Table 5). Similar trends to cook yields were obtained for water holding capacity thus showing that the latter may be a useful indicator for cook yields in laboratory trials.
Colour and flavour differences were also observed during these trials. Improvement in colour and particularly, flavour were observed using WPC (35%, HG). This may be due to lactose levels present. Lactose being a reducing sugar helps maintain reducing conditions within the meat system thereby helping to protect against oxidation of the meat pigments. The sweetness of lactose also helps mask the harsh flavour of salt.

Fresh Pork Sausage Trials

The functional requirements in a comminuted meat system such as fresh pork sausage, are fat binding, water binding, and binding of meat pieces together.
In this study fat levels of 30 % were used in the formulation to stress the system, thus facilitating observation of binding differences due to the added powders. The addition of protein powders (WPC 35%, SI and Egg Albumin) resulted in a reduction in fat and moisture loss, during frying.

Conclusion

Measurement of functional properties of protein ingredients using model systems, may give an indication of the potential use for such proteins in meat products. However, they will not always reflect accurately the behaviour of protein ingredients during the manufacturing, storage and preparation of the meat product.Therefore it is advisable to run small scale commercial trials in conjunction with such model sy stems.

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