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MICROSTRUCTURE OF MEAT BATTERS CONTAINING SOY PROTEINS

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Introduction

Soy protein preparations are commonly used as functional ingredients in finely comminuted meat products. When incorporated into meat batters they provide functionality of protein only (isolate) or protein and carbohydrates (concentrate). Thus their effect on microstructure characteristics of batter can be different. To investigate the influence of soy isolate and soy concentrate on distribution and size of fat particles in meat batters was the aim of the study.

Materials and methods

Meat batters were prepared of muscle proteins (lean trimmings of pork ham muscles), fat trimmings and water in proportion 4:1:1. They contained approximately 72% of water, 13% of protein and 14% of fat. All-meat batters were used as control samples. Then 10% of muscle tissue was exchanged for hydrated soy isolate or concentrate. No or 3% of salt was added to each batch. Two chopping sequences were used to investigate the effect of protein competition for water and fat. Standard conditions of chopping process were used (Seydelmann chopper model 40 Ras, bowl speed 30rpm., 6 knives, cutting speed 3600rpm). The temperature of batter was carefully monitored so as not to exceed 15^{o}C. Batters were sampled and prepared for histochemical examinations by freezing in liquid nitrogen followed by cryostat cutting sectionning. Fat was stained with oil red. Image Analysis System Imager 512 was used for size and number of fat droplets calculation.

Results and discussion

The strongest increase of the degree of fat dispersion was caused by salt addition to the batters. It was more remarkable in soy proteins containing batters than in all-meat ones. In all-meat batters the number of fat droplets was 1,6 times higher and in the case of soy isolate or concentrate addition 5,2 or even 6,2 times higher, respectively, than in reference batters without salt. When no salt was added, within all-meat batters the highest number and the smalest average surface area of fat droplets was found. In the presence of salt the best fat dispersion was observed within the batters containing soy protein concentrate. But it was not true if the chopping sequence was changed.

According to Hoogenkamp (1994) the dispersion and immobilization of fat during chopping is related to interfacial film formation and physical entrapment of fat particles within the meat matrix. If soy proteins are added to the system they compete for a water with muscle protein, but do not come into contact with fat particles because of fat preference for salt soluble muscle proteins. Comer and Allan-Wojtas (1988) reported the structures of soy proteins gels to be different from those of myosine but Katsaras and Cserhalmi-Ormai (1994) observed a coherent protein matrix of soy protein isolate, typical for protein gel. Soy concentrates disperssion formed bigger agglomerates of aggregated protein particles or even clumps. On the other hand it is known (Katsaras and Peetz 1994) that soy isolates demonstrate rapid uptake of water and that salt has the tendency to reduce the water absorption of soy proteins. Soy concentrates are even more sensitive to salt and its water uptake is smaller and slower than in the case of soy isolates. Under certain conditions high water capacity of soy isolates can cause, due to competition for water, a dehydration of other proteins or meat components.

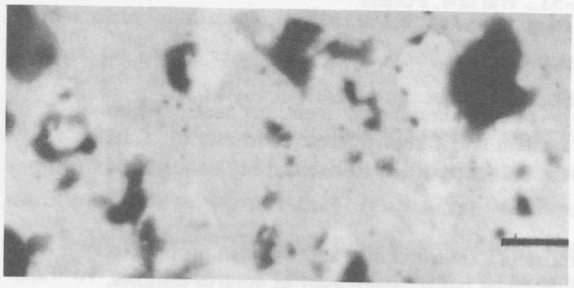
As it can be seen in figures 1 to 7 and table 1, under the conditions of experiment, soy proteins isolate in the presence of salt demonstrated the ability of fat particles immobilization similar to muscle proteins, but in the absence of salt, most likely due to competition for water with muscle proteins, soy proteins isolate caused failure of protein network resulting in significantly less number of fat droplets of larger surface area. In the case of soy protein concentrate the same effects could be observed in the absence of salt and when the soy proteins were first chopped in the presence of salt. When chopping started with classical method of muscle proteins extraction, the negative effect of the addition of soy concentrate was overcome by formation strong myosin gel network. It was facilitated, in comparison to soy isolate containing batter, by lower water uptake of soy concentrate. Thus the variations in soy preparations behaviour in meat batter regarding fat dispersibility, could be related to their different water capacity, water sorption rate, and gel forming ability.

Table 1. Degree of fat dispersion characterized by image analysis (Data for 10 windows)

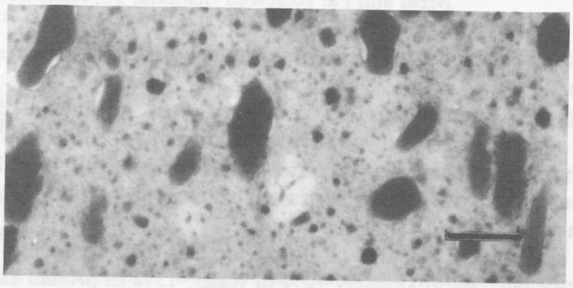
Sample code	Number of droplets	Average fat droplets area (μm^2) min.	max.	mean
0-M	1022	1,26	9891,11	184,94
3-M	1621	0,81	6120,76	107,33
0-SI-1	325	1,86	6918,38	455,11
3-SI-1	1696	0,98	5621,78	104,62
0-SI-2	431	1,50	10231,83	428,11
3-SI-2	1375	1,24	4752,83	135,91
0-SC-1	318	2,51	6805,05	414,00
3-SC-1	1972	0,85	5371,67	83,03
0-SC-2	472	1,36	9370,46	352,34
3-SC-2	579	1,80	5621,10	336,52

0 - no salt added; 3 - 3% salt added;
M - all-meat batter; SI - Soy isolate containing batter;
SC - soy concentrate containing batter
1-first muscle tissue chopped; 2-first soy proteins chopped

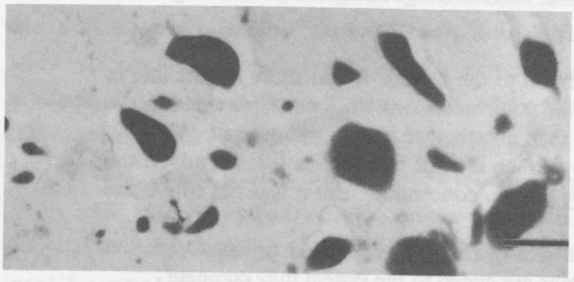
Microstructure of the meat batters. Bar = 100μm



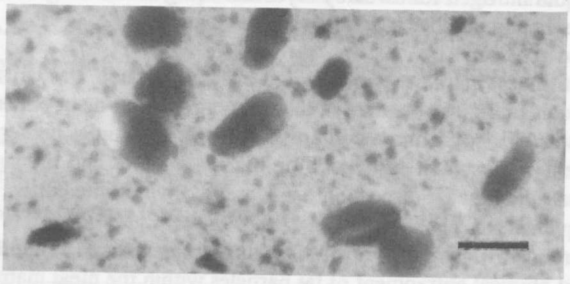
Sample 0-M



Sample 3-M

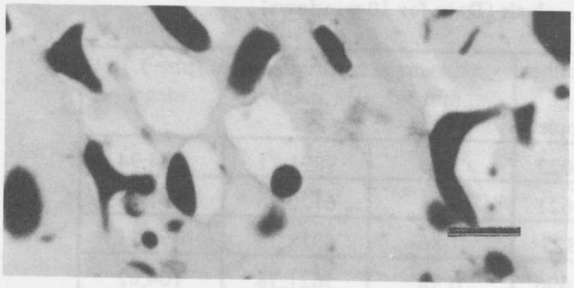


Sample 0-SI-1

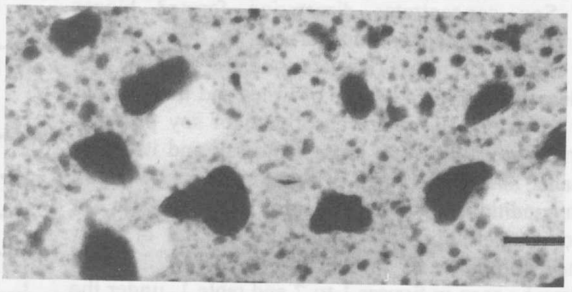


Sample 3-SI-1

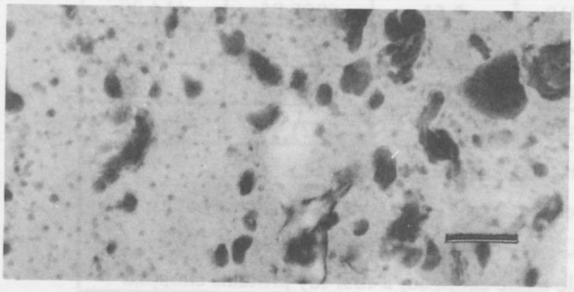
Microstructure of the meat batters. Bar = 100μm



Sample 0-SC-1



Sample 3-SC-1



Sample 3-SC-2

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