Meat curing (Beef, Deer, Duck and Turkey) by the Dewatering -Impregnation Soaking (DIS) Process

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BACKGROUND

Curing is one of the oldest known meat preservation processes. In the recent years, consumers from Western countries have shown a clear preference for cured products that have undergone very little processing. This implies that characteristics of these cured products should be fully controlled to ensure a suitable shelf-life. According to the uneasy control of traditional curing processes, the Dewatering-Impregnation Soaking (DIS) process seems to be an interesting alternative. This process consists of immersing foodstuffs into highly concentrated solutions, in order to dry and/or incorporate solutes simultaneously (Raoult-Wack, 1994). Meat processing by DIS, using mixed salt/sugar concentrated solutions at low temperature (10°C) was reported (Collignan & Raoult-Wack, 1992; Deumier *et al.*, 1996).

OBJECTIVES

The objective of this study was the improvement of traditional meat curing processes in term of mass transfers using DIS.

METHODS

Venison was obtained from a deer breeder in Aveyron (France). Beef muscles duck and turkey breasts were purchased from a local butcher. The characteristics of the raw meat are presented in Table 1. The solutes used in the DIS process were salt, corn starch syrup (CSS) (DE 38 and DE 21), sodium nitrite, ascorbic acid and polyphosphates. Beef and deer muscles were processed using DE 38 CSS. Duck and Turkey breasts were processed using DE 21 CSS.

The pilot immersion apparatus included a 20 litres heat-controlled tank to plunge a basket fitted with five trays. A pressure cylinder enabled vertical movement of the basket. This agitation allowed optimal mass transfers by preventing formation of a diluted surface layer on the meat fillets. The similar system (10 litres) was placed in a vacuum oven in order to perform experiments under vacuum conditions. Meat fillets were placed in the basket. The basket was immersed in the brine and vacuum was applied (<50 mbar). At the end of the experiment, the basket was pulled out of the brine after restoring atmospheric pressure. All experiments were conducted at 10 °C.

Mass transfers were expressed in terms of water loss (WL), salt gain (StG) and sugar gain (SuG) (in g per 100 g of initial matter). Experimental designs based on the Doehlert Uniform Shell Design were used to optimize the DIS process (Collignan & Raoult-Wack, 1994). The process variables were salt (Cst) and sugar (Csu) concentration in the solution and treatment time (t).

Water content was measured by desiccation in an oven at 104°C to constant weight. Fat content was obtained by Soxhlet extraction using N-hexane. Sodium chloride (salt) content was measured using a chloride analyzer (Corning model 926) after extraction in 0.3 N nitric acid. Sugar content (glucose, maltose, maltotriose) was determined by HPLC after alcohol extraction. Nitrite and ascorbic acid content was determined by reflectometry (RQflex, Merck). P_2O_5 content was assessed as indirect measurement of total phosphorus, by inductive coupled plasma.

RESULTS AND DISCUSSION

The kinetics of mass transfers given in figure 1 showed that DIS allowed to obtain high WL, simultaneous controlled StG and low SuG. Using experimental design methodology, the process variables were optimized in order to formulate products with the same characteristics than marketed dried meat products, as shown in table 2. In the case of deer salting and drying by DIS, some additives were added to the optimal solution (Csu= 1500 g/l and Cst=185 g/l) and the impregnation of nitrite, polyphosphates and ascorbic acid was followed during a 15 hours DIS. As shown in table 3, DIS enabled a complex product formulation with curing additives.

Figure 2 showed the effect of pulsed vacuum on mass transfers during turkey fillets immersion in salt concentrated solution. These first experiments showed that pulsed vacuum increased yields and StG. This could be explained by a vacuum-inducted dynamic porosity phenomena occurring in the meat and allowing a penetration of the solution in the muscle.

CONCLUSIONS

The present study presented the advantages of DIS process for salting and dewatering thin meat products in mixed concentrated salt/sugar solutions at low temperature. This study also demonstrated that meat products could be formulated directly within a single

DIS operation, involving the use of curing additives. If DIS is conducted under vacuum, impregnation is faster and yields are improved.

REFERENCES

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TABLE 1. Mean characteristics of meat fillets

	Beef	Deer	Duck	Turkey
Dimensions (mm^3)	70x70x9	78x65x8	entire breast	70x50x10[a] 70x50x20[v]
Water content (%)	73	75	70	74
Salt content (%)	0.09	0.13	0.06	0.08
Fat content (%)	3	1.4	6	1.5

[a] *Atmospheric pressure* [v] *Under vacuum*

TABLE 2. Optimal DIS conditions allowing to obtain products presenting the same characteristics than some marketed products

Targeted end-product	Optimal [NaCl](g/l)	experimental [CSS](g/l)	conditions t (h)	Mass WL[1]	transfers StG[1]
Dried beef (Grison Meat)	200	1000	15h	37.5	4.9
Dried Deer	185	1500	15h	47.2	2.3
Dried Duck Breast	225	1250	100h	21.7	2.8
Turkey Bacon	335	700	1h15	14.5	3.2
Cold smoked turkey	280	600	1h	10.4	2.5

[1] *in g/100 g of initial matter*

TABLE 3. DIS conditions allowing to formulate dried deer with curing additives (Csu= 1500 g/l; Cst=185 g/l; t=15h)

Additive	Concentration in solution (g/l)	Final product content (g/100 g)[1]	Additive gain (g/100g of initial matter)[1]
Nitrite	1	0.65	0.40
Polyphosphate	100	1.50	0.90
Ascorbic acid	6	0.03	0.02

[1] *mg/100 g for nitrite*

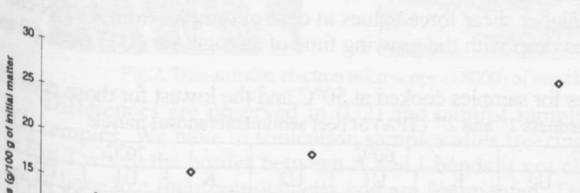

Figure 1. Kinetics of mass transfers for duck breasts during DIS (Cst=175 g/l and Csu=950 g/l - T=10°C - Atmospheric pressure)

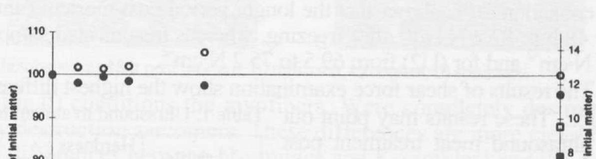

Figure 2. Kinetics of StG and yields for turkey fillets during immersion in salt concentrated solution (Cst=350 g/l - T=10°C) at atmospheric pressure and under pulsed vacuum (Cycles of 5 minutes under vacuum and 5 minutes at atmospheric pressure)