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THE EFFECT OF FREEZE STORAGE AND SALT CONCENTRATION ON EMULSIFYING CAPACITY OF THE PIG BLOOD PLASMA

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SUMMARY

Influence of pig blood plasma freeze storage on emulsifying capacity /EC/ using for preemulgation rapeseed oil and melted lard was assessed.Both the storage of plasma at -18°C for 3 months and the kind of fat /rapeseed oil and/or lard/ influenced the EC of plasma proteins.Concentration of NaCl: 0.9,1.5,2.0, 2.5 and 5.0% does not improve fat emulsification statistically significantly.Alkalization of plasma during first 2 months of storage was highly correlated with better EC /r = 0.999/. Higher value of EC was determined when rapeseed oil was used for analysis,instead of lard.Freeze storage resulted in partial protein agglomeration and formation of fluffs,suggesting denaturation of plasma proteins,although not detrimentally influencing EC value determined for the experimental periods of freeze storage.

INTRODUCTION

Freezing and spray drying are common preservation technologies of the animal plasma used as a substitute for muscle tissue protein.Emulsifying capacity /EC/ of protein solutions has been used by many suthors for comparative, model evaluation of functional properties of various protein preparations and their technological usability in meat processing as well as for the evaluation of several technological processes. The most freguent method used for the determination of EC of proteins is that by Swift et al /7/ In a number of modifications,this method was used for EC determinations when proteins were extracted from muscle tissues of different animal and/or plant species and protein preparations of animal origin /1,2,3,4,5/. However,meager are the reports on the evaluation of EC of slaughter animal blood plasma /3,6,8/. Hence,the authors of the present study attempted to determine EC of pig blood plasma proteins subjected to long-term frozen storage.The EC was estimated at different NaCl concentrations,using for emulsification either vegetable oil or lard.

MATERIALS AND METHODS

The experimental material consisted of 5 batches,each containing 5 l of fresh,edible pig blood plasma,industrially processed.The raw material was divided into 4 portions of 1 l each.One of them was used for initial determinations after 24 h storage at 4°C. The other 3 batches /in plastic bags/ were frozen in a lab freezer at-18°C and thus stored for 1,2 and 3 months.The following indices were determined in the initial and frozen plasma after consecutive 1 month storage periods: protein content /by Kjeldahl's method using coeff.=6.25/,pH and dry matter. Prior to analytical determinations,blood plasma was thawed at 4°C for 24 h and then homogenized at 4°C and 5000 r.p.m. for 1 minute,so that the agglomerates and protein fluffs formed during freezing and/or frozen storage were comminuted.EC of plasma protein was determined by Swift's method /7/ in the following way:25 ml of fat preemulgator heated to 38°C were introduced to a vessel thermostated at 38°C wherein the emulsifying process was performed.The preemulgators were either rapeseed oil or lard.Next,20 ml solution of pig blood plasma in a brine was introduced to a test set in which protein concentration was 500±5 mg/100 ml. Then,in a homogenizer,both phases were pre-mixed at 8000 r.p.m. for 30 seconds.Without switching off the homogenizer,oil was rated into the preemulgators,using the micropump of constant capacity 20 ml/min.EC was determined on the basis of electric conductivity rapidly decreasing when emulsion collapsed. The EC was expressed in ml of oil/100 mg of protein.EC of protein plasma solutions for each freezing time of the experimental material and for both pre-emulgators were determined in the brines of the following NaCl concentrations:1.5,2.0,2.5 and 5.0%. The data were analysed statistically using Duncan's multiple range test with replications.The differences were tested on the basis of LSD at p=0.05.

RESULTS AND DISCUSSION

The protein content in 5 portions of pig blood plasma,determined after 24 h from its collection,averaged 5.84%.After 1,2 and 3 months of frozen storage the protein content

decreased slightly and averaged 5.73% for any of the storage periods.No significant effect of frozen storage on protein content in the blood plasma was found.Similar were the differences observed in dry matter content:11.0% initially /after 24 h chilled storage/and 10.63% in the experimental fro - zen stored material.Frozen storage resulted in the increased pH of the plasma;from initial value of 7.50 to 7.77 after 1 month storage and to 7.97 after 2 and 3 months of frozen storage /fig.1/.Non-standard thermal conditions were used for the analysis determining the EC of blood plasma proteins for lard as a preemulgator.The mean final temperature after emulsification for any of 400 replications ranged from 38.5± 0.3°C.Regarding the facts mentioned above it should be assumed that partial thermal denaturation of blood plasma proteins was possible apart from interfacial protein denaturation and denaturation on the fat/water interface which could affect the EC being determined. The analysis of the effect of a preemulgator on EC proved that irrespectivelly of the storage periods used for plasma and NaCl concentrations,the melted lard used for initial emulsification /model= lard+oil=L+O/ decreased the EC value as compared to the model in which only rapeseed oil was used both in the phase of preemulsification and emulsification/ model =oil+oil=O+O/,/figs. 2, 3/.The statistical differences were significant /p=0.05/.The evaluation of the effect of frozen storage on EC proved statistically significant increase in the EC of blood plasma proteins after 2 months frozen storage in comparison with the EC values of unfrozen plasma and plasma stored for 3 months in either model systems,i.e. O+O and L+O /fig.2/. Elevated EC of the frozen plasma proteins stored for 1 month and the differences in EC observed between 1-2 months of storage, as well as decreased EC after 3 month storage as compared to the plasma stored for 1 month,were not statistically significant for either experimental models,i.e. O+O and L+O /fig.2,4,5/.The increased EC observed in pig blood plasma frozen stored for a period up to 2 months is correlated with concurrent alkalization /r=0.999/.However,the data presented in fig.2 indicate that the differences in EC do not result only from pH since the EC of blood plasma proteins considerably decreased after 3 months of frozen storage.This phenomenon reguires further investigation focused on qualitative changes in lipoproteids,lipids and free fatty acids /FFA/ of plasma,as well as potentially possible interactions of the substances mentioned abowe and the products of their decomposition with plasma proteins.It is assumed that these may exert an adverse /denaturising/ effect on protein solubility and thus also EC.The model of the experiment presented above did not prove any significant effect of progressively increasing NaCl concentration on EC values in the emulsified blood plasma solutions,However, varying EC in the function of NaCl concentration,observed at any period of frozen storage in the case of both preemulgators suggests the decreasing EC in 1.5% NaCl solution of plasma protein and progressing elevation accompanied by the increased NaCl concentration up to 5%,has not been accidental /Figs.4,5/.The experiments on this phenomenon are continued.The hypothesis suggesting the decisive impact of fibrinogen on the EC of blood plasma at NaCl concentrations higher than 2% seems to be highly possible.

CONCLUSIONS

1. Frozen storage of pig blood plasma /-18°C, 3 months/does not result in the deterioration of its functional properties,such as EC.
2. The reasons for reoccurence of the smallest EC value at 1.5% NaCl concentration independently on the time of plasma frozen storage are under investigation.

LITERATURE

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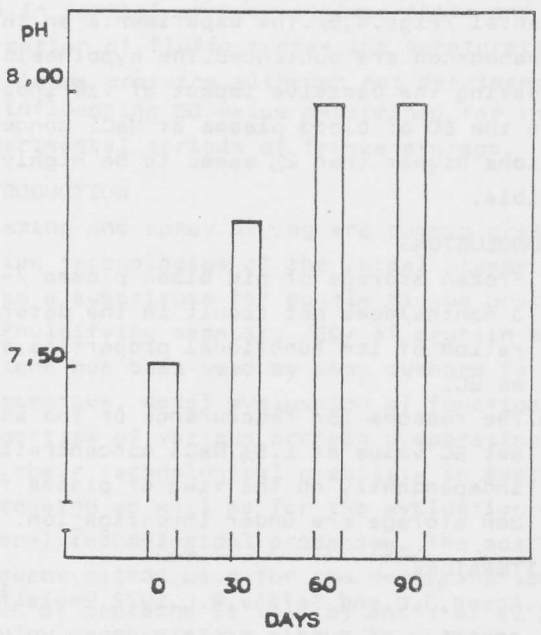

Fig.1.Changes of plasma pH during frozen storage.

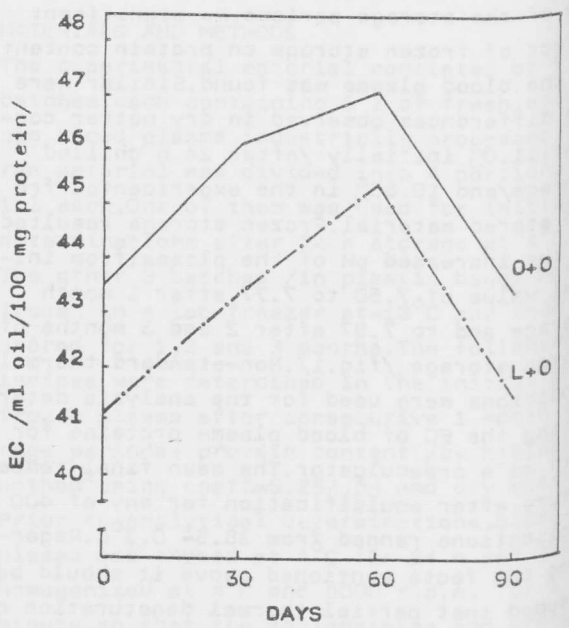

Fig.2.EC of pig blood plasma influenced by long term frozen storage.O+O,L+O = rapeseed oil and melted lard used as preemulgators,respectively.

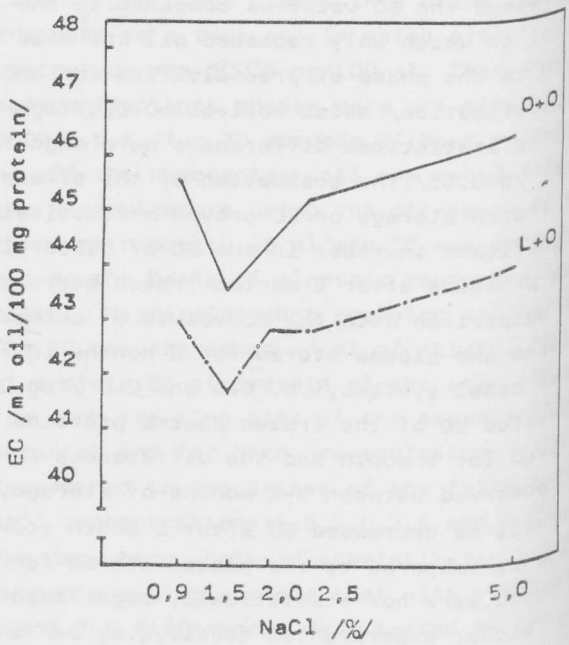

Fig.3.Influence of differentiated NaCl concentration on EC of chilled and frozen stored pig blood plasma.O+O and L+O as Fig.2.

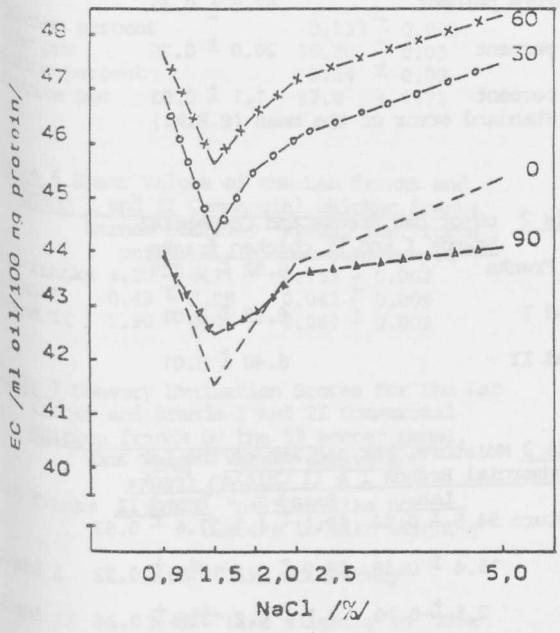

Fig.4. EC of chilled and frozen stored pig blood plasma using rapeseed oil for preemulgation influenced by differentiated NaCl concentration. 0= fresh, chilled plasma, 30,60,90 = days of frozen storage of plasma.

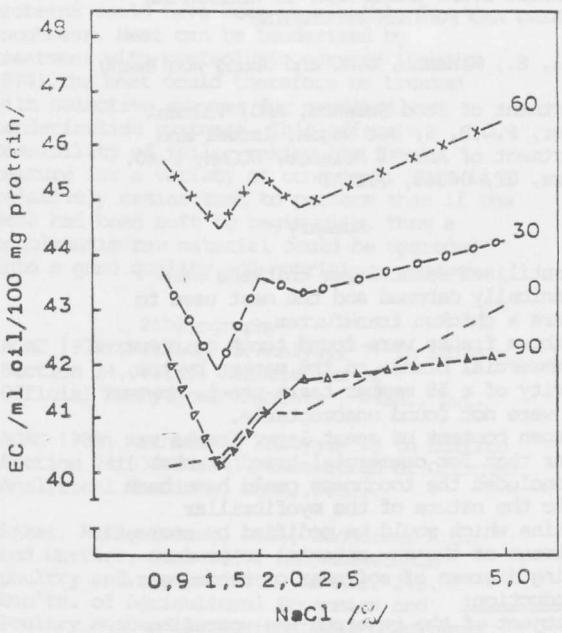

Fig.5. As for Fig.4 but using melted lard for preemulgation.