Improving meat fatty acid profile

Researchers at TEAGASC, in collaboration with Nanovex Biotechnologies, Spain, have been looking at the application of nanoencapsulation and ultrasound technology to improve the nutritional quality of meat by modifying its fatty acid profile.

Pork is a rich source of proteins and contains a number of bioactive molecules. However, pork also contains high levels of lipids, which have been a topic of discussion for meat consumers due to their associated health implications. Relationships between dietary fat intake and incidence of various lifestyle disorders, including cardiovascular diseases, are well established, and several health agencies have specific guidelines in this regard. Several strategies have been employed to improve the nutritional value of meat, for example: the reduction of caloric value and fat content; reduction of cholesterol content; increase of amino acid quality; enrichment with minerals, vitamins and antioxidants; reduction of sodium, nitrite and phosphate contents; or, enhancement of fatty acid profile, as in this research. Research studies carried out at Teagasc showed that the incorporation of encapsulated polyunsaturated omega-3 fatty acids into meat can enhance the fatty acid profile of pork meat.

Encapsulation technology

Encapsulation of bioactive food ingredients provides a barrier and protection from unfavourable processing conditions while preserving the nutritional properties of the ingredient. In recent decades, encapsulation technology has shown several potential applications in the pharmaceutical and functional food industries. Encapsulation involves packing the target ingredient within a wall of material to form capsules.

Several techniques are available in order to encapsulate targeted fatty acids, the most popularly employed approaches being coacervation, spray drying, spray chilling, extrusion coating and liposome entrapment by thin film hydration (TFH). Incorporation of microencapsulated oils has been carried out in a range of food matrices for various potential health benefits; in this particular work, food-grade materials were employed. However, incorporation of encapsulated ingredients in solid foods, e.g., meat, is challenging compared to liquid foods, since diffusion rates are low and the oil is not effectively dispersed into a solid food matrix. Among several techniques investigated to date, ultrasound has shown its potential for use in the assisted diffusion of a number of ingredients within food matrices. For example, the application of power ultrasound can enhance sodium chloride (NaCl) diffusion rates into the meat, making the process faster and resulting in a more homogeneous product. This technique has resulted in an improvement of brining processes, for example.

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Development of nanovesicles

Fish oil, a rich source of omega-3 fatty acids (eicosapentaenoic acid or EPA (42%) and docosahexaenoic acid or DHA (16%)), was encapsulated

Table 1: Characteristics of nanovesicles based on their formulation.

Nanovesicles	Average size (nm)	Polidispersity index	Zeta potential (mV)	Particle concentration (vesicles/mL)
Lipo-N	352.8±8.5[a]	0.266±0.037[a]	14.4±0.1[b]	5.8 x 10^{12a}
Lipo-Cat	345.9±5.1[a]	0.319±0.010[a]	51.3±1.0[a]	7.2 x 10^{12a}

[a,b]*Values followed by same superscript are not significantly different (p<0.05).*

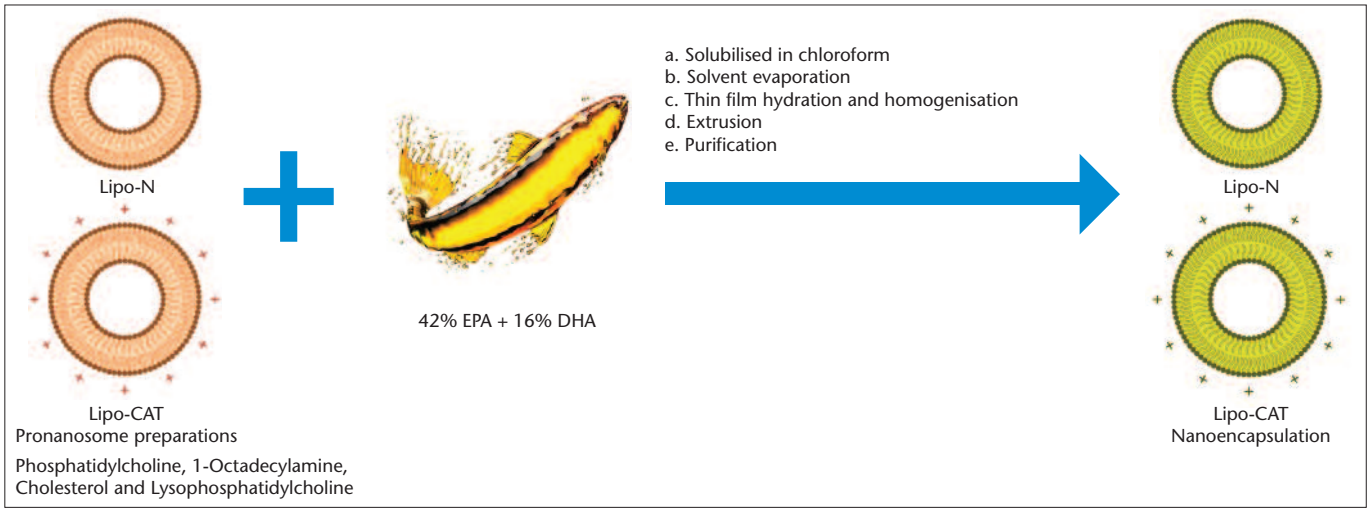

FIGURE 1: Preparation of nanovesicles.

into nanovesicles using Pronanosome Lipo-N and Pronanosome Lipo-Cat formulations by means of TFH (**Figure 1**). The characteristics of the nanovesicles developed are shown in **Table 1**.

Incorporation of fatty acids

A study carried out by Teagasc has shown that ultrasound treatments of pork meat cubes submerged in the corresponding nanovesicle suspension in an ultrasonic bath system can improve diffusion of nanovesicles into pork meat. Application of ultrasound at 25kHz for 60 minutes significantly increased the level of omega-3 fatty acids in the meat matrix, regardless of the nanovesicle formulation. This effect is mainly ascribed to the increased amount of EPA and DHA incorporated with the nanovesicles. The content of these two fatty acids was primarily affected by ultrasound treatment and time. Longer treatments significantly increased ($p<0.05$) the amount of omega-3 fatty acids present in the final product. In general terms, all long chain polyunsaturated fatty acids (PUFAs), which are present in the encapsulated fish oil, experienced a positive effect following ultrasound treatment. These results indicate that ultrasound enhanced the mass transfer of encapsulated oil into the meat samples. Therefore, a positive effect on the fatty acid profile of pork meat was promoted, since the ratio between saturated and polyunsaturated fatty acids was favourably modified.

Conclusions

A combination of two novel technologies, namely nanoencapsulation and ultrasound, has been applied in order to improve the lipid profile of pork meat. This study has demonstrated the positive effect that ultrasound application, when combined with encapsulated fish oil, had in increasing the amount of healthy fatty acids in pork meat.

Further reading

Ojha, K.S., Perussello, C.A., Garcia, C.A., Kerry, J.P., Pando, D. and Tiwari, B.K. (2017). 'Ultrasonic-assisted incorporation of nano-encapsulated omega-3 fatty acids to enhance the fatty acid profile of pork meat.' *Meat Science*, 132: 99-106.

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