Microscopic analysis of how processing changes texture in chicken

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Introduction & Summary

Over the last couple of years, discussions about ultra-processed food have become increasingly common in the media and have captivated the nation's interest. These foods have also become increasingly common in British schools, including our own; British children have the highest rate of ultra-processed food consumption in Europe, with a 2022 paper showing that they account for 64 per cent of the calories in school-provided meals. As we started to look closer at the packaging of our school meals we noticed unusual ingredients.

In this experiment, the appearance of organic chicken breast was compared to that of processed popcorn chicken from the school canteen under the electron microscope. A survey was then conducted to see if different methods of processing have any identifiable effects on the physical appearance of the meat.

Fig.1a: Booths organic chicken breast (cooked)

Fig.1b: School canteen popcorn chicken.

Research aims

This research aims to show how processing chicken can have noticeable and identifiable changes on its structure and appearance on a microscopic level.

The objectives were as follows:

- Take images using the electron microscope that accurately and fairly represent the samples.
- Compare the organic cooked chicken breast and school canteen popcorn chicken, and draw contrasts and similarities between them.
- Survey the school population to investigate whether they could also identify the differences.

Hypothesis

Processed meat differs to organic unprocessed meat in structure and appearance at a microscopic level due to the processes and chemicals used.
Processed popcorn chicken will have a smoother and more uniform structure whilst the organic cooked chicken breast will show a more natural form with recognisable features.
Students will be able to identify which SEM scan is popcorn chicken due to its distinct texture.

Experimental Method

Samples were taken from two different foodstuffs; a cooked organic chicken breast and popcorn chicken from our school canteen.

1. Samples of 0.5cm² were cut as thin as possible for the best results under the SEM . This was a lot easier with popcorn chicken, due to it's unnaturally uniform texture.
2. After being patted with a paper towel to remove excess oil, they were stuck onto specimen stubs with carbon adhesive tabs.
3. The stubs were then inserted into the sample holders and loaded on to the microscope stage. A Hitachi TM4000 Plus SEM was used.
4. Once the sample chamber was closed and the air had been evacuated, images were taken at 100x, 250, 500x and 1000x magnification.

Results

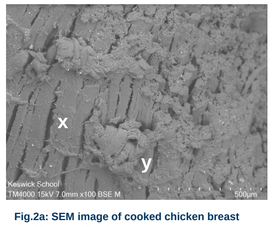

Fig.2a: SEM image of cooked chicken breast at 100x magnification

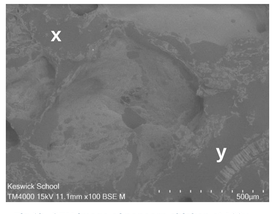

Fig.2b: SEM image of popcorn chicken at 100x magnification

These results show that popcorn chicken has an observable difference in texture to organic cooked chicken. For example, large areas of dark, unidentifiable composition (Fig.2b, x) and an irregular exterior with disaggregated fibres and muscle (Fig.2b, y). In comparison, the images of organic cooked chicken show it to be uniform with strong indication of muscle fibre and fats, shown by the streaky indentation in the surface (Fig.2a, x) and light coloured, fatty tendons (Fig.2a, y).

Analysis

The observations of the popcorn chicken samples are caused by the way the meat is processed. The overall chicken breast content of the popcorn chicken, as shown in the ingredients list, is 51% (although the fried coating is included in the overall percentage). This confirms that the meat has been ground down and reformed with other ingredients added. Some of the other ingredients include: yeast acidity regulator, citric acid, water, sunflower oil, pea fibre, pea starch, salt, stabilisers, bi-triphosphates.

Pea fibre and pea starch are used to modify and improve the texture of the product, bind the protein mixture together and extend its shelf life. This is also aided by the yeast acidity regulator and citric acid which preserve the food by increasing the products acidity, preventing the formation of bacteria, mould and other organic contaminants. Sunflower oil is likely used to improve flavour in a cheaper, more long lasting way, while stabilisers are used to stop the oil and water separating and generally preserve the food. Sodium triphosphate is a preservative commonly found in meats, poultry and animal feed; it is used as an emulsifier and to retain moisture.

Although not inherently dangerous, the addition of emulsifiers and preservatives indicate that's the base ingredients being used are of lower quality (for example, battery hens as opposed to free range) which could have a negative impact on the environment and our health.

Survey

A survey was conducted with the images from the electron microscope. The question was:
"Which of the two images (Fig.3) is popcorn chicken?"

Of the 505 students we asked, 75% chose option 2 (which was the correct answer) with the remaining choosing option 1 (cooked chicken breast). This shows how different methods of processing can be seen clearly when compared to each other.

Conclusion

In conclusion, the popcorn chicken has a noticeable difference in texture to organic cooked chicken on a microscopic level, which can be easily identified by consumers.

Fig.4: SEM image of cooked chicken breast at 1000x magnification

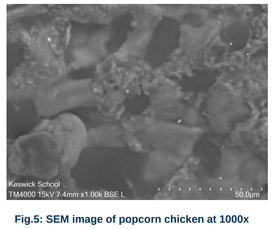

Fig.5: SEM image of popcorn chicken at 1000x magnification

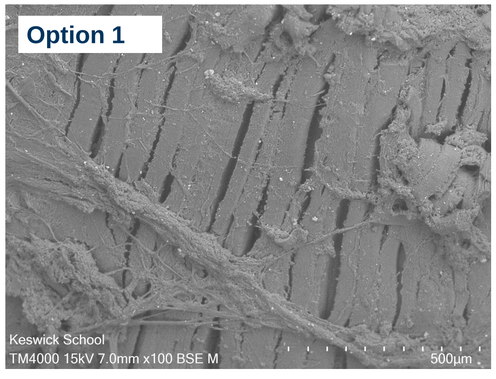

Fig.3a: SEM image of cooked chicken breast at 100x magnification.

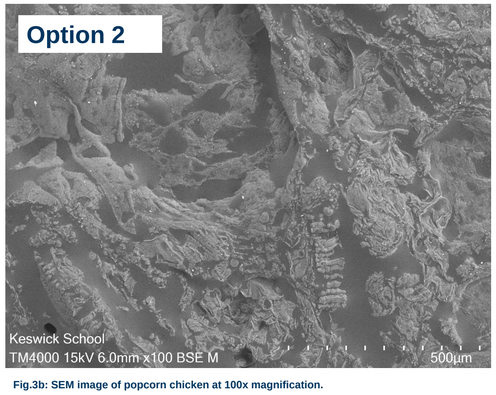

Fig.3b: SEM image of popcorn chicken at 100x magnification.

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