Economic Adulteration: Beyond Melamine

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Five years ago, the increasing number of renal failures in dogs and cats alerted the authorities to a problem in the pet food supply chain — melamine and cyanuric acid were being added to pet food.[1] Food ingredient producers who were adding these chemicals did so with the intent of exploiting the long-standing system of payment for ingredients.

Rather than payment on weight, which was often exploited throughout history, the food industry pays ingredient suppliers based on nutritional parameters, including content of protein or fat. Protein content is invariably quantified using either the Kjeldahl wet chemistry method or the Dumas combustion method. Both methods, however, rely on measurement of nitrogen content and directly relate the value to protein by an arbitrary number. This means that adding high nitrogen content compounds to protein containing foods generates a higher protein content reading — and a higher price.

This same process was seen in the case of the 2008 milk adulteration scandal where additional melamine allowed further dilution of milk to give a consistent protein reading and increase profits dishonestly.[2] Directly affecting the human food supply chain, this case resulted in fatalities and hospitalization linked to melamine-laced infant formula.

Economic Adulteration: A Common Pastime

In the past, adulterants used in food products largely have been non-harmful to humans. A common adulterant to honey, for instance, is high-fructose corn syrup.[3] This will not cause humans any harm, but is still fraudulent and means the consumers and processors are not receiving what they paid for.

The work by Moore et al in 2012,[4] showed that, via literature review, the most adulterated ingredients were olive oils, then milk variants, followed by honey, saffron and orange juice.

For olive oils, the problems include pomace oil masking as extra virgin and virgin olive oil, and Californian olive oil masquerading as Italian olive oil and blending with other lower cost oils, with hazelnut being most common.[5]

For milk, melamine and watering down are key issues. Future problems include addition of proteins themselves, such as tannery products and other nitrogen-containing compounds.[6]

Saffron is widely adulterated, with Safflower stigma reproducing the distinctive yellow color of Saffron, and powdered Turmeric being used in place of powdered saffron to provide a yellow color and pungent flavor. Other spices such as cloves and peppercorns can have their oil removed and sold separately before the selling the peppercorns and cloves themselves.[7]

Finally, orange juice is often pulp-washed or sold under the guise of having a high-quality origin when it is actually from lower value origins. Other high-value juices, such as pomegranate, are often blends of other juices such as grape and apple with added colors.

Combating Economic Adulterants Today

To combat this, food processors and retailers are asking the question: “How can food ingredient producers be better monitored to ensure quality?”

Nutritional measurements are used to ensure accuracy of certain properties, including protein, moisture and fat. Random tests for contaminants, such as melamine or *E. coli,* are carried out to decrease risk and verify the Certificates of Analysis generated by the suppliers. Food companies will also audit suppliers to ensure compliance to safety regulations is being upheld.

The challenge with these precautions is that they exist against the backdrop of a global recession, which means that the ingredients are more frequently shipped from countries, such as China and India, where economic adulteration is more common and auditing is of a lower standard. Furthermore, budget cuts cause food companies to do more testing with fewer and fewer analytical chemists. Finally, the fraudsters carrying out the adulterations are becoming more sophisticated, employing more techniques to mask their crimes.

The answer to these issues is non-targeted, low-cost screening. By implementing easy-to-use equipment to stop poor-quality, potentially-dangerous ingredients from going into the production lines, fraudulent suppliers can be identified and prosecuted.

Near infrared (NIR) allows faster analysis of these properties as opposed to traditional wet chemistry methods. Food processors are investigating NIR as a technology to do this as it is a technology with which they are familiar. It can also be used by low-skilled workers and can identify economic adulterants in most food types without incurring huge costs. This hunt has invariably begun by identifying melamine in milk powder, but is being expanded to other areas. One such area is that of monitoring for adulteration in dietary supplements.

Technology, such as the PerkinElmer Spectrum One Fourier Transform Infrared Spectroscopy (FT- IR) spectrometer, can be used to help ensure products are free from adulterants. Traditionally used for analytical testing of substances, such as polluted soil and biodiesel blends, the FT-IR possesses AssureID software, which compares similarities and differences in the spectral data and delivers an easy-to-read printout of whether or not the sample passed or failed the test. Food and dietary supplement companies can use the unit’s capabilities to compare the sample’s FT-IR spectrum against authentic samples to decide if the sample is likely to be contaminated with adulterants.

Overcoming Economic Adulterations

The challenges for manufacturers are to take existing NIR technologies and make them screen for economic adulterants on top of existing nutritional measurements. Manufacturers must make the measurement even simpler to use, from both software and hardware perspectives, to put them into the hands of lower skilled workers. Additionally, it is imperative to improve the transferability of the methods across multiple sites to ensure consistent results. These steps will allow food companies to finally move ahead of the fraudsters and our food supply.

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