Information Sheet: Identifying High Risk Raw Materials – Use of "Big Data"

Prepared by John Points Consulting, March 2017

Chemical and Fraud Risks in Food

The range of analytical testing available for food authenticity verification or chemical contaminants is vast. It is important that resources are targeted towards the areas of highest risk, for both customer protection, brand protection, and cost control. The Pareto Principle applies: a small percentage of ingredients account for the vast bulk of the risk.

Most food manufacturers have a good feel for the raw materials they would regard as high risk. This is largely based upon previous issues; "usual suspects" such as aflatoxins in peanuts, or adulteration of palm oil with red dye.

The Importance of Systematic Risk Assessment

A systematic assessment of risk is more difficult. It requires a detailed knowledge of the source of the raw material, it's production, and supply chain. For example, to assess the risk of pesticide residues in rice you would consider the licencing and sales controls of pesticides in the country of origin, the need for their use (diseases, pests and climate), seasonality, whether their local market (or their primary export market) rules for residues differ from the EU rules, the degree of education and agronomic support for farmers, whether the supply chain is a large integrated grower or a consolidation of multiple "cottage industry" suppliers.

Use of Historical Testing Results in Risk Assessment

A systematic and future-looking risk analysis is complex, and the easier option is often to fall back upon previous test results. There is a place for this, as part of the risk assessment armoury. However, relying upon simple trends in "positive" results can be misleading, and in some cases can lead to business decisions that are worse-than-random.

The key metric needed for sound decision-making is the rate of incidence of a hazard in a raw material from a particular source – the "percentage positive". However, this is rarely available in databases and reports. All that is reported are the positive results, not the negatives. There are some exceptions – *e.g.* the UK Pesticide Residues in Food surveys[1], or own-company due diligence test results – but these are generally too small to be statistically significant.

Pitfalls in Using Historical Results

Positive results, reported without the context of the corresponding negatives, drive increased testing throughout the industry. This can result in a self-perpetuating spiral of testing of a raw material (for example, nitrofuran antibiotic residues in Bangladeshi prawns in the late 2000's[2]) whilst other materials that are higher risk remain untested. Worse-than-random decisions can arise when sourcing policy is based upon these trends. For example, a known issue with pesticide residues in yardlong beans from Thailand and The Dominican Republic led to them being included in Directive EC/669/2009 for

intensified checks (50% of consignments to be tested) at EU import. But subsequent data suggested the same problems with yardlong beans from other countries; Thailand and Dominican Republic happened to be the ones that had been tested the most (and were tested much more, following this Directive, driving an apparent upward trend in positives). Thus if a food manufacturer had chosen to delist Thai yardlong beans in 2010, they could have inadvertently switched to an alternative source that had just as high a risk of pesticide residues, but was not subject to the same checks and controls at EU import.

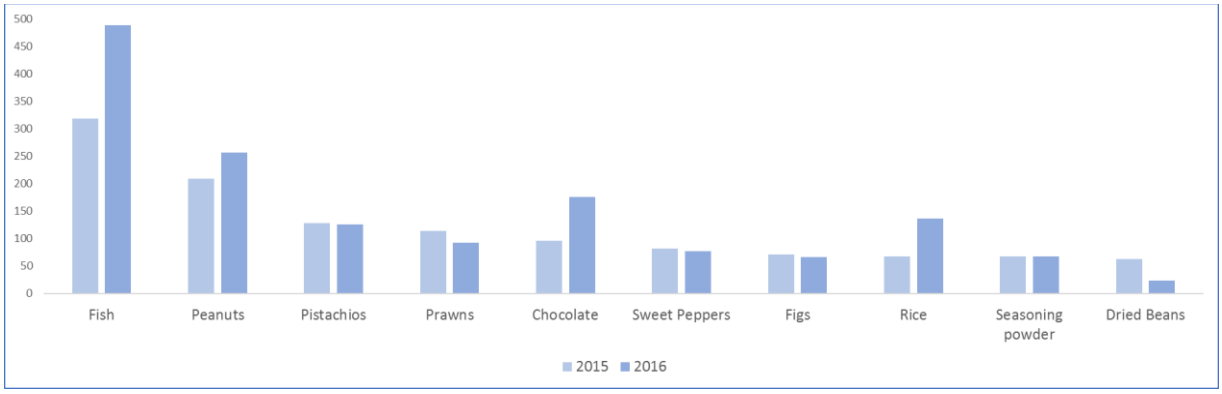
Future Outlook – The Advent of Big Data

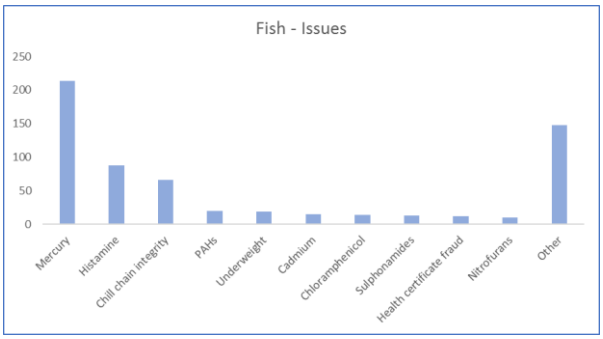
Within the next decade, it should be possible for food manufacturers to collate meaningful trends in incident rates. There are statements of intent from national governments, trade groups, the European Commission, and other international bodies on publishing "Big Data". In this context, this means both positive and negative test results, in a database format that is easy for interested parties to interrogate and manipulate.

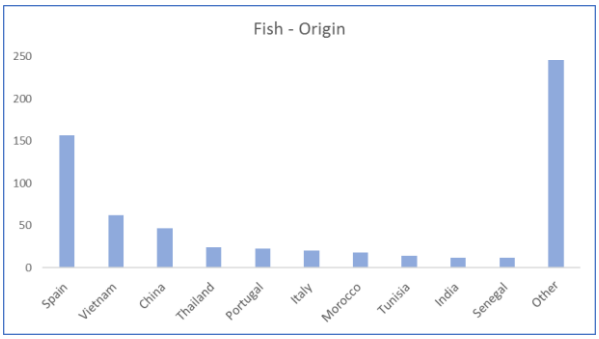
Current Approach – Intelligent Manipulation of Data

In the interim, there are other approaches to manipulate the number of positive results published on sources such as Horizonscan[3]. One method is to normalise trends as the number of positive results per production tonnage, or per import tonnage. This is still imperfect; it does not account that one commodity or source may be tested more than another; it may over-represent low-weight commodities such as spices; it may under-represent commodities such as rice where most production is consumed in countries where there is less testing and reporting of problems. Nevertheless, it can give a very different picture of relative risk, as illustrated by re-ranking the raw materials typically used by UK food manufacturers that feature most frequently on Horizonscan.

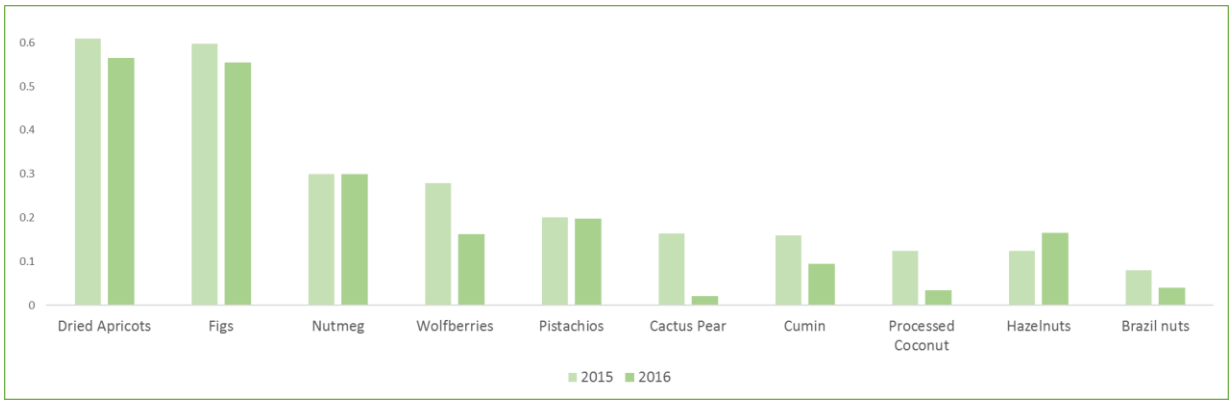
Simple View: Absolute number of Incidents (Chemical and Authenticity)[3] – Top 10 Raw Materials





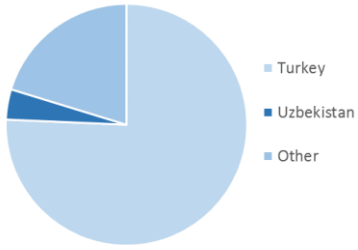


Alternate View: Number of Incidents per ,000 Tonne Production[4] – Top 10 Raw Materials

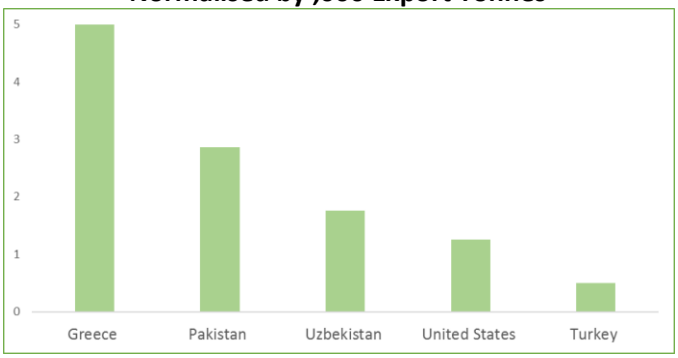


Dried apricot issues were, almost exclusively, excessive or undeclared sulphites. The next question is whether any particular country of origin is higher risk. It is in cases such as this, when comparing like-with-like, that it is invaluable to normalise data if possible. A simple count of the "positive" results on Horizonscan would suggest that the risk is firmly centred on dried apricots originating from Turkey. But Horizonscan data for sulphites mainly consist of test results from within the EU: Turkey is, by far, the biggest exporter of dried apricots into the EU. When "positive" results are normalised against export volumes, with the caveat that sample numbers are small, it appears that dried apricots from some of the smaller producing countries have a far higher incidence of sulphites.

Simple Picture:
Count of Horizonscan Results



Refined Picture:
Normalised by ,000 Export Tonnes



Conclusion

Assessing the likelihood of chemical contaminant or authenticity issues in food is a difficult and subjective process, requiring a detailed knowledge of the production conditions, economics and supply chain of each ingredient. In order to target resources for certification, testing and audit, any attempt at risk assessment is better than none.

The advent of "Big Data" will make risk assessment simpler; once "negative" as well as "positive" test results are published, then the incidence of different issues can be estimated. Until this time, drawing conclusions based purely upon historical "positive" results is inadvisable. It is important to think critically about how and why the results were generated, if there is an inherent bias, and if there is any way to correct for this bias. Corrections may be subjective and imperfect but – again – any attempt is better than none. It is important to recognise if conclusions are sensitive to uncertainties in assumptions and data manipulation. Different conclusions can have a profound effect on the cost and effectiveness of supply chain integrity programmes.

Footnotes

1 PRiF Surveillance Reports, https://www.gov.uk/government/collections/pesticide-residues-in-food-results-of-monitoring-programme

2 Nitrofuran paper

3 Horizonscan (subscription required), https://horizon-scan.fera.co.uk

4 Without the purchase of expensive market reports, estimates of production and trade figures can be uncertain and difficult to find, particularly for processed raw materials. Figures to produce the charts in this paper were taken from FAOSTAT (the most recent year data available for each commodity – generally 2013), FAO "The State of World Fisheries and Aquaculture 2014", and International Nut and Dried Fruit INC "Global Statistical Review 2014-2015"