



Crop Quality Testing

IMPORTANT CONSIDERATIONS

Crop Quality | Part2

Why crop quality testing

CROP QUALITY TESTING is an essential aspect of agriculture, as it helps farmers and agribusinesses ensure that their crops meet the required standards for marketability and consumer safety. There are 2 main aspects of crop quality testing. The first set of quality tests inspect the key constituents of the crop, while the other set examines whether the crop is safe for consumption from a toxin infestation / pesticide residue / adulteration standpoint

Important aspects of crop quality testing

1. **Sampling:** Sampling is a critical aspect of crop quality testing. Samples should be representative of the entire crop and taken at different stages of production to ensure accuracy.
2. **Testing Parameters:** The parameters for crop quality testing will depend on the type of crop and its intended use. Common chemical parameters include moisture content, protein content, oil content, starch content, sugar content, and contaminant levels. Common physical parameters include colour, size, shape, weevil infestation, shrivelling, brittleness and bulk density.
3. **Testing Methods:** There are various methods available for crop quality testing, including laboratory analysis, in-field testing, and non-destructive methods such as NIR spectroscopy for chemical parameter testing and image analysis for physical parameter testing. The chosen method should be accurate, reliable, and appropriate for the crop being tested.
4. **Accuracy and Repeatability:** Crop quality testing should be accurate and precise, with minimal error. Accuracy refers to how closely the test results match the true value, while repeatability refers to the consistency of results when the test is repeated.

5. **Standardization:** Standardization is crucial for crop quality testing to ensure that results are comparable and consistent across different laboratories and testing methods. Standardization can include the use of certified reference materials and the development of standard operating procedures.
6. **Regulations and Requirements:** Crop quality testing must adhere to regulations and requirements set by government agencies, industry associations, and buyers. Compliance with these regulations and requirements is necessary for marketability and consumer safety.

Conventional methods used for crop quality testing

For physical parameters, physical inspection is commonly used. Below table explains some of the physical parameters that are commonly tested.

Table 1 – Physical parameter tests for spice quality (purity focused)

| Parameter | What is tested | How is the test done |
|----------------------------------|---|--|
| Purity -Cleanliness | Percentage of foreign and extraneous matter like insect contamination, excreta, foreign bodies | Physical method – microscopic analysis of known quantity of spice sample |
| Bulk density/ bulk index | Volume vs weight analysis – tells us whether the inner matter in the spice body is intact or wasted / eaten by insects? | Physical method - weight per unit volume measurements complying to requirements stipulated by various standards bodies |
| Appearance - Shape/ Size/ Colour | Uniformity in colour, size and shape | Visual methods - based on this, grading is done to determine and segregate superior or inferior quality. |

Chemical parameter testing

Laboratory procedures are available and well standardized for crop quality testing, as pertains to chemical parameters that determine the quality of the crop. For example, in spices, there are key secondary metabolite chemicals that determine the goodness of the spice – in Turmeric, there are naturally occurring chemicals called Curcuminoids, in Pepper, there is Piperine, in Chilli there is Capsaicinoids. In all spices there are also volatile and non-volatile oils that determine the flavor profile and taste of the spice.

These chemical parameters are tested in crop samples using standardized lab procedures released by standards bodies. These standard procedures are accurate and can provide repeatable results, when analysis is conducted per defined procedure by trained analytical chemists, using well calibrated and maintained instrumentation that are required for the analysis procedures. These are the primary methods of testing.

The primary lab methods of crop quality testing are invariably time consuming and require specific skill sets and expensive instrumentation. Therefore, they are not very accessible to the public or even people in the agri-commodity value chains.

Due to the inaccessibility of lab base chemical parameter testing of agri-commodities, there is a big lacuna in determining the quality of the crop that is coming for trade, that is being purchased in bulk for further processing, as well as for export. Objective price determination becomes impossible due to the lack of instant and portable testing of agri-commodities.

Below table gives a flavour of the various chemical parameters to be tested in commodities. This table only an example – due to the very diverse nature of crop metabolites and secondary metabolites, the list of parameters typically tested is actually very large and with advances in instrumentation, also growing.

Readers are requested to consider this as an example starter table.

Table 2 – Chemical parameter tests for crops (purity and potency focused)

| Parameter | What is tested | How is the test done |
|-------------------------------------|--|--|
| Purity - Ash content | Determination of the level of impurities in a product, by burning off the organic matter and measuring the residue of ash | Analytical lab: Destructive method - This measurement is carried out by incinerating the herb or spice at 550°C to constant weight |
| Purity – Acid Insoluble Ash content | Determination of the cleanliness of the herb or spice | Analytical lab: Destructive method is done along with the ash content by boiling the ash in 2N HCl and incinerating the residue (again at 550°C) to a constant weight |
| Moisture | Determination of how much moisture is remaining in the spice – moisture will increase the weight of commodity sold | Analytical lab: Destructive methods Chemical analysis methods like Dean and Stark method are typically used |
| Water activity | Determination of whether there is less than enough moisture to support growth of bacteria, mold and such undesirable organisms | This is actually a physico-chemical parameter. Water activity meters which determine whether the water activity of the tested sample is within prescribed limits |
| Volatile oil content | Determination of availability of contents that determine the flavour level of the spice. Also helps to determine adulteration. | Analytical lab: The herb or spice is boiled under reflux conditions with water where the oil separates on top of the water. The volume of oil can be read as volume proportional to the sample mass. |

Near Infra-Red Spectroscopy based crop testing

However, there is a secondary method for such instant testing, which is based on Near Infra-Red Spectrometry, details

Near-Infrared Spectroscopy (NIR) is a non-destructive analytical technique that measures the absorption, transmission, and reflection of light in the near-infrared range of the electromagnetic spectrum. NIR spectroscopy can be used for crop grading because it can quickly and accurately measure various parameters related to crop quality, such as moisture content, protein content, oil content, starch content, sugar content, key secondary metabolite content and various such other key ingredients in a crop.

We will explain more details about NIR based quality sensing in a subsequent article.