pH meter Standard Operating Procedures

pH measurement:

One of the main factors influencing pork quality is muscle pH. pH is defined as the negative log of the hydrogen ion concentration – or simply the acidity of the muscle/meat. Post-mortem lactate formation in the muscle causes the pH to decrease. pH meters are used as a tool to objectively measure this characteristic and can be used as an indicator of pork quality.

pH meters commonly used in the meat industry:

Many different meters are available for measuring the pH of meat. Some of the common ones being used are below:

- **MPI (Meat Probes, Inc.)**

  Pros: handheld device with no cords, great for on-line measurement (especially when taking multiple measurements), records sequence with each measurement, data is easily downloaded

  Cons: price, newer models exist, larger and heavier compared to other meter options

  Some MPI pH meters can manually adjust for temperature, some cannot, check specific models

  Website: http://www.meatprobes.com/

- **Hanna HI98163 – Professional Portable Meat pH Meter**

  Pros: price, records sequence with each measurement, data is easily downloaded, can adjust temperature manually

  Cons: cord connecting probe to handheld device, more pieces to try and keep up with, not an effective tool for use at commercial line speed if taking multiple quality measurements (pH and color)

  Some Hanna pH meters can manually adjust for temperature, some cannot, check specific models

  Website: https://www.hannainst.com/

- **Hanna Halo**

Pros: small handheld device, price – most economical option, Bluetooth connectivity – easy to use with a phone, can adjust temperature manually, data is easily downloaded

Cons: not an effective tool for use at commercial line speed if taking multiple quality measurements (pH and color), device does not record sequence with each measurement

Website: https://www.hannainst.com/

Note: not all pH meters are equipped for downloading data after taking measurements. Check specific pH meters for this capability, and if not equipped, data will need to be recorded using a datasheet and blue pen - record the sequence and pH reading for each measurement, along with ID of carcass or primal, if necessary. If unsure on the process for downloading data, it is good practice to record data with a datasheet as a backup.

pH probes:

The key to obtaining good, reliable pH measurements depends less on the pH meter itself and more on the quality of the pH probe used with the meter. It is important to use a pH meter fitted with a pH probe that is designed for determining pH in food products.

The two most common probe types used for measuring meat pH are the glass tip or the non-glass ISFET (ion-selective field effect transistor) probe.

- These tips are spear shaped to allow insertion into an intact muscle. The ISFET probe is desirable from a food safety standpoint because it reduces the risk of broken glass tips contaminating the meat.
- Glass tip probes are more accurate and reliable. The main challenge with an ISFET probe is that it is difficult for the sensor to make proper contact with the meat since it is slightly inset in the probe. An ISFET probe also has a slower reaction time compared to glass. Despite the drawbacks, it may be necessary to use ISFET probes in processing plants that forbid the use of glass-tipped probes.
- Another middle-ground option is a stainless-steel piercing blade around a glass probe (like pictured above with the Hanna HI98163) and is a good option in some plants. Like the ISFET probes, the piercing blade allows insertion into an intact muscle without the slower reaction time of an ISFET probe. However, the piercing blade may prevent proper contact with the meat which could result in poor readings. Depending on the plant you are working with, there are good options for complying with different requirements, however, glass tip probes are overall the most accurate and reliable option.

Calibration and operational procedures:

The calibration and storage procedures of a pH meter are key to obtaining consistent, reliable pH results.

Calibration

- Meters should always be fully charged, or batteries checked before use – it is good practice to charge pH meters 24 hours before using and always have backup batteries.
- Calibration of the pH meter should be conducted with fresh pH 4.0 and 7.0 buffer at the start of each day. Recheck calibration throughout the day with the pH buffers. For a glass probe, use a Kimwipe or tissue when going between buffers, this will help ensure buffers are not contaminated.
    - Smaller plastic bottles filled with buffer are often used for calibration, this ensures ease of calibration and avoids contamination of the larger bottles of buffer. Smaller bottles are easier to refill from larger stock bottles and ensure fresh buffer is being used – it is good practice to replace the buffer in small bottles periodically.

    - Replacing the buffer in smaller bottles is dependent on the frequency at which they are being used, but a good rule of thumb is to replace these buffers after a week's worth of use.
- If a pH probe has not been used for more than two days, soak the probe in calibration buffer for 30 minutes prior to calibration to prevent drift in the measurement.
- For calibration, the temperature compensation should be adjusted to the ambient temperature (if the pH meter automatically adjusts the temperature, no action needed). Ambient temperatures generally range from 22 – 25 °C but are dependent on the environment where you are calibrating.
- After successfully calibrating the pH meter, place the probe back into each buffer to ensure accurate readings. If the reading is off by more than 0.05 pH units, recalibrate.

Recalibrate if the calibration is off by more than 0.05 pH units

- After each measurement, the probe should be visually inspected for any damage (cracks, broken glass, etc.), especially when using a glass tip probe. If a probe is damaged, identify the carcass or primal in some form and immediately notify the plant to avoid product contamination.
- It is also good practice to recheck the probe in each buffer periodically throughout the day and again at the end of use to confirm that calibration is still acceptable.

Storage

- Store the pH probe tip in pH calibration buffer after calibration and during long periods between measurements (>1 minute). When storing pH probes overnight, the probe tip should be placed in either storage solution (4M KCl or similar) or buffer solution (4.0 or 7.0 pH).

- pH electrodes become dirty with use and can produce inaccurate results. After using the pH probe and meter, wipe down with a Clorox or Lysol wipe to remove debris and ensure cleanliness of the equipment.
- For longer storage periods (> 1 week), using storage solution is preferable to buffers. Buffers should be stored in airtight containers. Excessive air exposure will deteriorate the buffers.
- Buffer and storage solution should also be replaced periodically to ensure best results and accuracy of calibration.
    - For larger bottles of buffer and storage solution, it is good practice to comply with the expiration dates printed on the bottle.

Buffers: pH Buffer Calibration Solution Kit 2-Pack

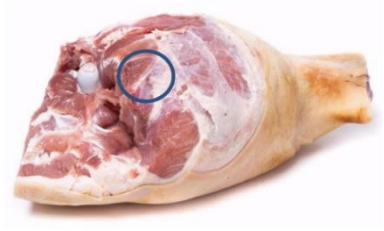
Storage solution: pH Electrode Storage Solution (500 mL)

pH electrode storage caps: pH Electrode Storage Cap with Compression Fitting

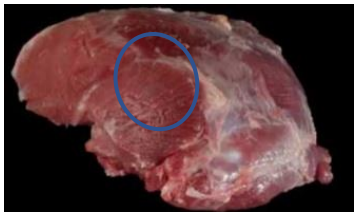
pH measurement location:

Typically, pH is measured in either the ham or the loin.

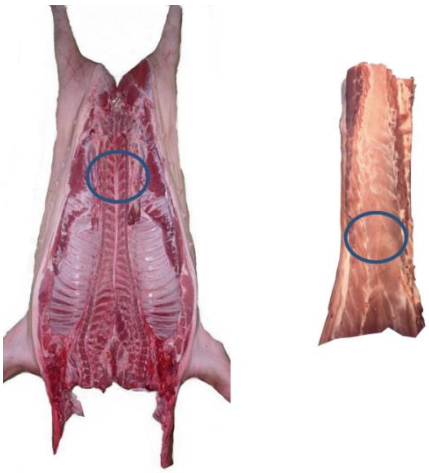
- Ham pH is most commonly measured in the semimembranosus muscle, while loin pH is measured in the longissimus muscle.
- These two locations are often considered the worst-case scenarios for pH, thus accounting for more variation for detecting differences due to genetics and/or environmental factors.
- The loin and ham pH can be collected on the intact carcass or on the individual primals, depending on which method works best in the processing facility.
- When measuring pH in the loin of an intact carcass, measure between the 10th and last ribs to avoid measuring muscles other than the longissimus.
- The pH probe should be inserted into the muscle so that the entire electrode, glass probe or non-glass ISFET probe, is submerged under the surface.



Fresh bone-in ham, semimembranosus muscle circled



Fresh semimembranosus muscle



Pork carcass and chilled pork loin – pH measurement locations circled

Temperature compensation:

- Depending on where you are taking pH measurements (slaughter floor, cooler, cut floor, etc.), you will need to manually adjust the temperature setting to ensure the most accurate reading (if the pH meter allows manual temperature compensation). The temperature compensation function (automatic or manual) of a pH meter will help account for any temperature effect, although the automatic function may delay reading time.
- Temperature will vary depending on the plant you are working with and the location within the plant - slaughter floor, cooler, cut floor, etc. It is good practice to temp carcasses or primals in the location where you will be taking pH measurements and use that temperature for the pH meter.

Troubleshooting:

As you measure pH, there may be some instances where you need to do some troubleshooting to ensure accurate and reliable pH measurements. Additional troubleshooting information is included with the pH meter and should be referenced when resolving specific issues.

Duplicate and abnormal readings:

- If you receive several of the same measurements in a row, you should check the pH meter in both 4.0 and 7.0 buffers and recalibrate, if necessary.
- pH measurements below 5.0 and above 7.0 are abnormal. If you receive those measurements, recalibrate the pH meter.
- There may be times when pH readings take longer to stabilize or seem to “climb” or “bounce” around before producing a stable reading. “Drift” is a term you may hear and refers to the slow movement of a reading from the actual or expected pH. This may be more difficult to recognize but occurs when measurements consistently trend higher or lower than expected over time. Analyzing data and plotting measurements can help identify this issue.
    - If you notice the pH meter having difficulty stabilizing or drift of measurements, you should soak the probe in buffer and recalibrate.
    - Many factors can cause drift - contamination of the reference electrode inside the probe, a plugged or blocked junction, damage to the probe, electromagnetic interference, or an old electrode.
    - If thorough inspection of the probe for damage (cracks, air bubbles, low electrolyte level inside the probe) and cleaning the probe, soaking in buffer, and recalibrating do not resolve this issue, the probe may need to be replaced.
- If the probe is damaged or continuously reads inaccurately, consider replacing it.

Frozen screen and error messages:

- Depending on the pH meter, you may rencounter a frozen screen or an error message. If so, follow specific instructions based on the pH meter. However, battery replacement or turning the device off and then on again may resolve the issue.