TARGET PORK QUALITY

Use of pH meters at pork processing plants

Aim

Pork quality and production efficiency can be enhanced through better selection and process control by monitoring the muscle pH of pork carcases. This fact sheet provides information to assist the industry in making use of pH measurement as a monitoring tool for quality management.

Benefits of using pH meters as a monitoring tool

Three key processing areas can substantially benefit from pH monitoring:

1. **Production efficiency:** Carcase pH is directly related to the amount of drip loss and thus, the final yield of meat sold. Pork shelf-life is also greatly influenced by post-mortem pH.
2. **Meat quality:** pH is a good detector of poor meat quality. pH information could be used to segregate carcases for more efficient use and to monitor process performance.
3. **Pig welfare:** Poor pH carcases may indicate a potential stress-related problem. These problems can be properly addressed only if identified.

Monitoring of carcase pH will help to identify production efficiency, meat quality and welfare problems. Corrective actions addressing these areas can only be taken after analysis of current trend or identification of specific problems.

To improve productivity, quality or welfare in your factory:
Measure and Monitor them FIRST!

Background

The muscle pH of living pigs is around 7 to 7.2. After slaughter, the lack of oxygen and nutrients reaching muscles triggers an enzymatic process called glycolysis. Lactic acid is built up in the muscle as a consequence of glycolysis. This induces a pH drop to about 5.5. The rate of pH fall contributes to a range of meat quality characteristics including colour, exudate and shelf-life.

pH values are measured generally at two time points: 45 min and 24 hours post-mortem, referred to as pH_{45} and pH_{24} respectively. There are two muscle conditions associated with abnormal pH fall: PSE (pale, soft and exudative meat) and DFD (dark, firm, dry meat). Both PSE and DFD characteristics are associated with poor production efficiencies, poor eating quality and in most cases, with animal stress.

PSE

PSE meat can be identified by a rapid initial pH fall (lower pH_{45}) and slightly lower pH_{24}. Pork with a pH_{45} lower than 6 is very likely to present PSE characteristics. PSE pork is wet, pale, low yield and tough when cooked. In addition to a genetic predisposition, PSE is caused by severe acute stress lasting for seconds or minutes immediately before slaughtering. Coercion, movement through the race, restraining, heat stress or mixing are common causes of acute stress.

	PSE Pale, soft and exudative meat	**DFD** Dark, firm and dry meat
pH fall	Very rapid rate	Reduced extent
Definition	**pH_{45} < 6**	**pH_{24} ≥ 6**
Cause	Acute stress *(lasting for min/sec)*	Chronic stress *(lasting for tens of min/hours)*
UK pork prevalence ***(estimated)***	15%	5%
Main associated problems	• Pale colour • Excessive drip or purge in packaging • Low yield in processed products • Low yield as fresh meat and tough when cooking • Dry taste and poor texture	• Dark colour • Poor processing potential (uneven water holding capacity, abnormal colour development) • Poor flavour • Very prone to spoilage and short shelf-life

BPEX Pork Chain Unit

DFD

DFD meat is characterised by a reduced extent of acidification and thus, a high pH_{24}. Pork with a pH_{24} above 6 is very likely to present DFD characteristics. DFD pork is dark, firm and dry meat which is prone to spoilage and with poor processing potential. The main reason for DFD development is chronic stress which lasts for tens of minutes or hours before slaughter. Prolonged food deprivation periods, transport fatigue and fighting between unfamiliar pigs are frequent causes of chronic stress.

Measurement of carcase pH is a monitoring tool which may help you improve production efficiency, pork eating quality and even welfare standards.

Routine carcase pH monitoring will allow you to:

1. Picture the trend in quality of pigs being processed.
2. Identify poor quality carcases, preventing them from entering premium range products.
3. Take corrective action (i.e. identification of particular farm or hauliers showing high incidence of abnormal pH carcases).

All you need is a suitable pH meter and properly trained staff.

Recommendations for taking measurements:

- Measure 10% of kill across producers on a different day each week
- Always measure at the same time points, aiming for 45 minutes and 24 hours
- Measure in the longissimus dorsi at the head of the last rib
- Use an average of triplicate measurements where possible
- Check calibration before every set of measurements, following manufacturers' guidance
- Ensure proper maintenance and cleaning of probes
- Ensure staff are trained in use of pH meters

Commercially available pH meters

The lack of suitable commercial pH meters is the main reason given for the lack of routine pH monitoring. It is generally perceived that there is no easy-to-use, fast, food-approved, resilient and reliable equipment available.

As result, a trial comparing the performance of some commercial portable pH meters suitable for the food industry has been conducted by BPEX in collaboration with the University of Bristol through the Pork Chain Unit.

The best performing equipment is presented in the table opposite. The devices tested were both traditional measuring systems using glass electrodes (the first four devices) and ISFET technology which utilises a non-glass element (the last device). The table illustrates some of the key parameters to take into account when selecting equipment for pH monitoring. Individual processors should decide which may be the most suitable for their individual requirements.

Accuracy*: the average difference between probe and control:

"3a*" = Average difference between probe and control was 0.2 pH units or less

"3b*" = Average difference between probe and control was 0. 1 pH units or less

Precision:** the lower and upper limits of agreement:

"3a**" = The majority of measurements were within ± 0.5 pH units or better

"3b**" = The majority of measurements were within ± 0.2 pH units or better

Practicalities*:**

"3"or "X" as assessed by a well trained person who took all the measurements through the whole practical exercise.

It was not possible to assess the life-time performance of the equipment but an indication of the guarantee period is given. Durability is an important feature but it should be noted that it is determined by how regularly the equipment is used and how it is handled (i.e. correct use, proper maintenance). According to the manufacturers, all devices assessed were food-approved, and the probes containing any glass components were made of special material which is break-resistant. Nevertheless, care is needed when handling glass electrodes in any food environment.

The pH manufacturing companies have expressed interest in the feedback from our trial and it is worth discussing your specific requirements with them. If there is sufficient demand, development may yield devices better suited for pork processors.

Remember:

- ***Both PSE and DFD characteristics are associated with poor production efficiencies, poor eating quality and in most cases, with stress-associated problems.***
- ***Measuring pH is a monitoring tool which may help you improve these factors.***
- ***All you need is a suitable pH meter and properly trained staff.***

Best performing equipment as assessed in the evaluation exercise

Available from	Klipspringer (meter) Sentek Ltd. (probe)	Testo Ltd.	Testo Ltd.	Hanna Ltd.	EDT Ltd.
Model	**NORONIX PHT 1140+ 130/77**	**205**	**230/03**	**HI 99163 /FC 23D**	**IQ150/ pH 57-SS**
Starting Kit Price (2007)	**£285.00** £135.00/ £150.00 (meter/probe)	**£243.40**	**£563.70**	**£279.95**	**£500.00**
Accuracy*					
pH_{45}	3a*	3a*	3a*	3a*	Xa*
pH_{24}	3b*	3b*	3b*	3b*	3b*
Precision **					
pH_{45}	3a**	3a**	3a**	3a**	Xa**
pH_{24}	3b**	3b**	3b**	3b**	3b**
Practicalities*** (1 very poor to 10 very good scale)					
Stable reading	8	9	8	9	5
Easy to use	6	9	7	8	9
Maintenance	6	8	7	6	9
Additional prices (2007)					
Buffer solution (£)	7.25 / 500ml	9.50 / 250ml	12.90 / 50ml	8.00 / 230ml	12.50 / 500ml
Storage solutions (£)	12.00 / 150ml	Not needed	21.10 / 50ml	8.50 / 230ml	Not needed
Replacement probe (£)	92.50	116.50	151.80	130.00	225.00
Guarantee period					
Probe (months)	12	6	6	6	6
Meter (months)	12	24	24	24	32

Note: Prices are given as a guide and are subject to change

pH manufacturers/ suppliers contact details

NORONIX PHT 1140 meter + 130/77 probe

Separate Temperature Probe

Supplied by Klipspringer Instrumentation

01473 741500

info@klipspringer.co.uk

and Sentek Ltd

01376 340456

sentekuk@btconnect.com

Hanna HI 99163/FC 23D

Integrated Temperature Probe

Supplied by HANNA Instruments Ltd

08707 260010

david.richards@ hannainst.co.uk

Testo 205

Integrated Temperature Probe

Supplied by TESTO Ltd

01420 544818

www.testo.co.uk

Q 150 pH 57-SS

Integrated Temperature Probe

Supplied by EDT Direct ION Ltd

01304 829960

judi@edt.co.uk

Testo 230/03

Separate Temperature Probe

Supplied by TESTO Ltd

01420 544818

www.testo.co.uk