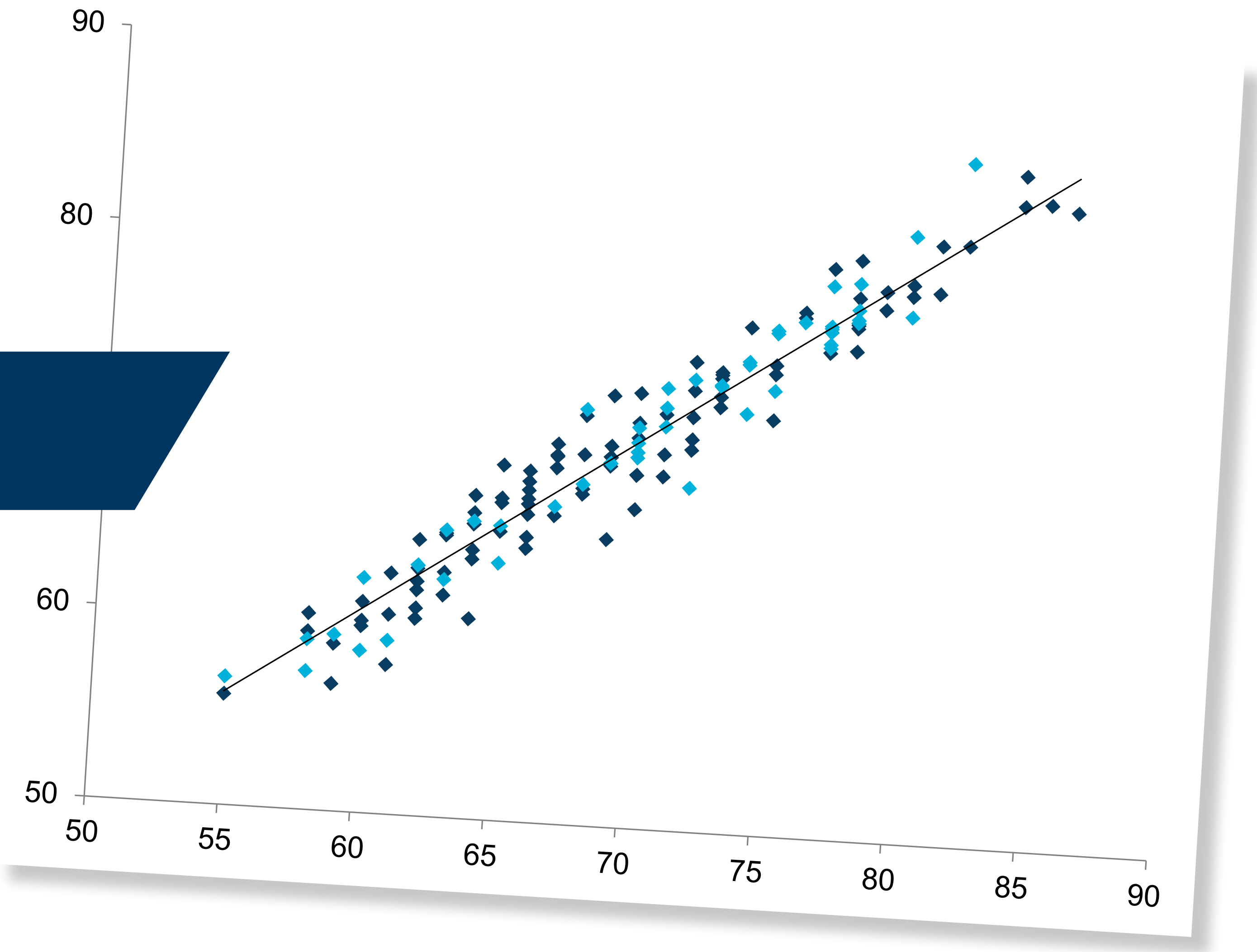
FRONTMATEC

Technical note

NitFom™



NitFom™ Technical note by

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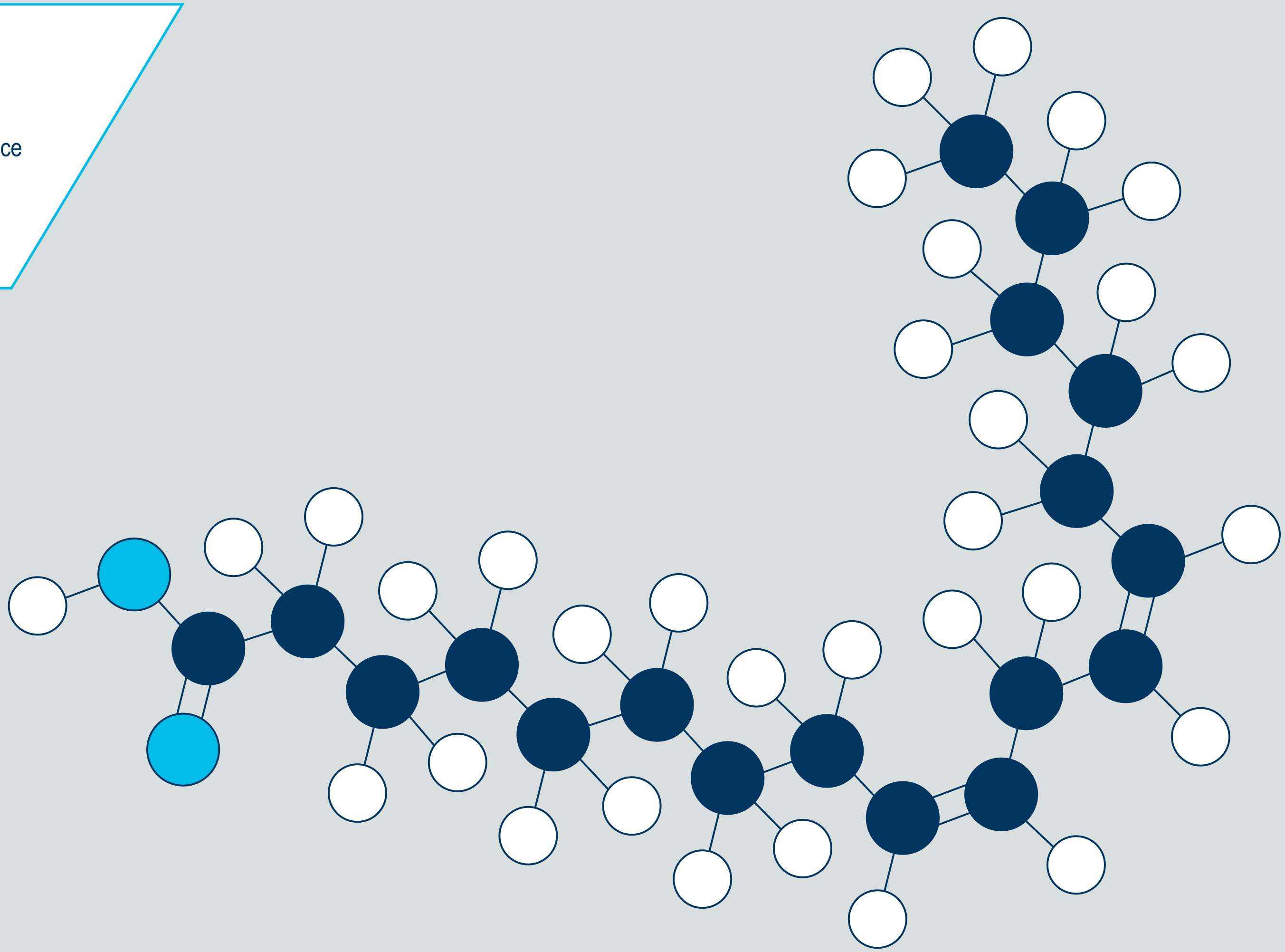


Low iodine values

- Higher feed costs/better cutting yields/longer shelf life/higher melting point/firm fat

High iodine values

- Lower feed costs/poorer cutting yields/shorter shelf life/lower melting point/soft fat

Introduction

The chemical composition of pork fat influences several quality traits important for the slaughter industry. The content of unsaturated and saturated fatty acids affects fat texture, color and product shelf life. Pork fat with a high content of polyunsaturated fatty acids is soft, yellow and is more prone to oxidation during storage. The soft fat texture gives rise to poor technological quality as it reduces cutting yields and sliceability of especially bacon and fermented sausages and also results in reduced shelf life. The chemical composition of fat is affected by, among other things, the feeding regime. Feeding pigs with products such as maize, rapeseed or distillers dried grain will increase the unsaturation of pork fat. On the other hand, such feeding compounds provide for a cheaper way to achieve a desired weight and lean meat relation. So, as with many other issues in pig industry – it is an optimization task for the entire value chain.

Early prediction of the fatty acid profile and iodine value (degree of unsaturation) will allow the slaughter industry to use rapid information on fat quality both as a sorting tool and a quality control tool.

NitFom is a handheld fast-track measuring device based on Near-Infrared Transmission (NIT) which provides the iodine value or fatty acid profile within a 2.5 sec. measurement cycle and as such renders the NitFom fully operational at line speed.

NitFom consists of stainless steel twin-probes mounted in a probe house. Each probe is knife-tipped and designed to penetrate 3 cm into the carcass through the skin. Optical fibers connect the emitter probe to a light source while the receiver probe is connected to a NIR-spectrometer. The two probes have windows facing each other allowing light to be transmitted through the fat tissue. As the probe head is ejecting itself from the carcass, NIT spectra are recorded at several depths.

A built-in algorithm facilitates differentiating tissue types (meat vs. fat). Only spectra recorded in fat tissue will be part of the predicted fatty acid profile and iodine value of the carcass. The speed with which the NitFom probe is retracted from the carcass determines how many spectra are obtained.

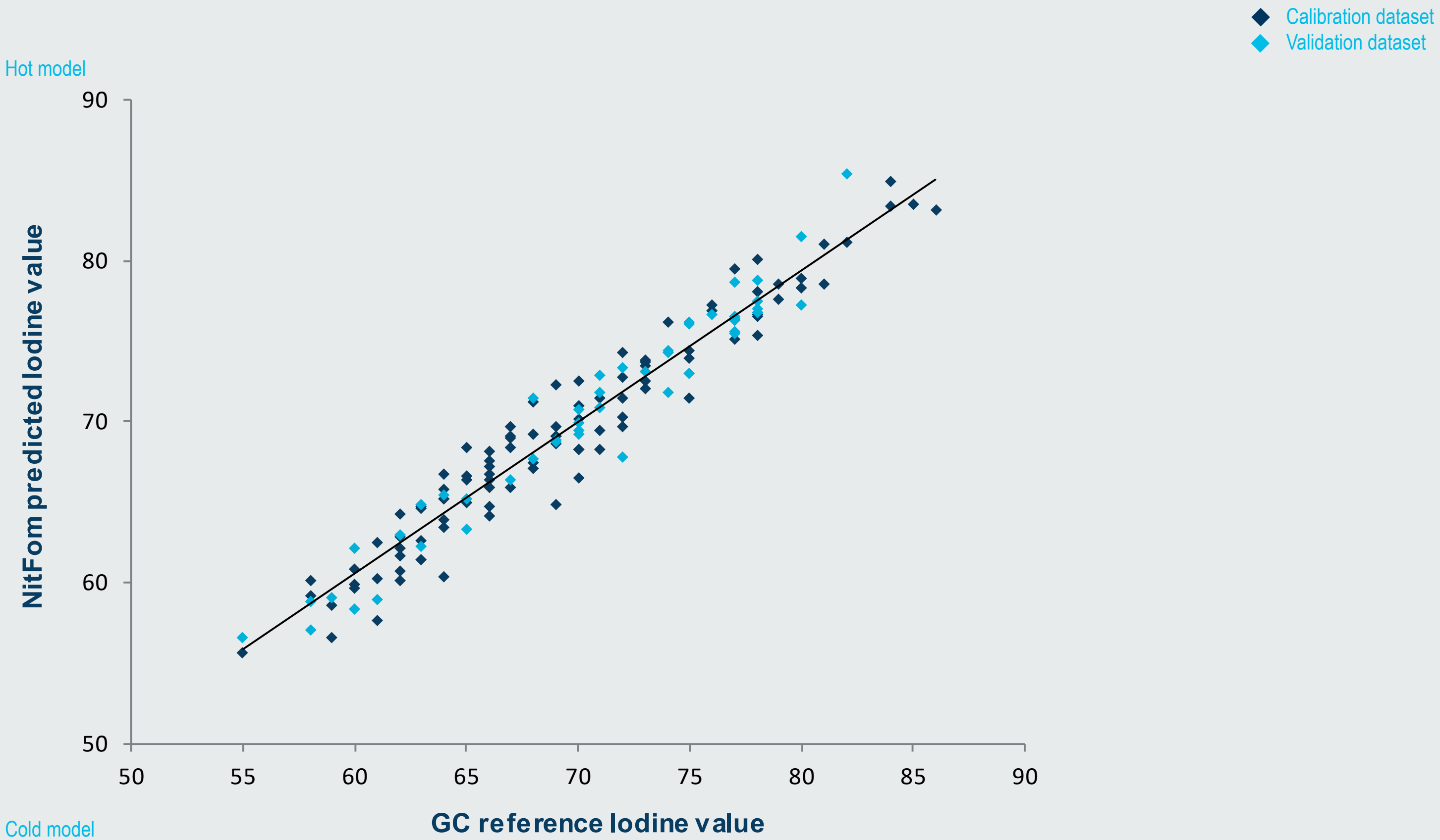
NitFom models for iodine value prediction

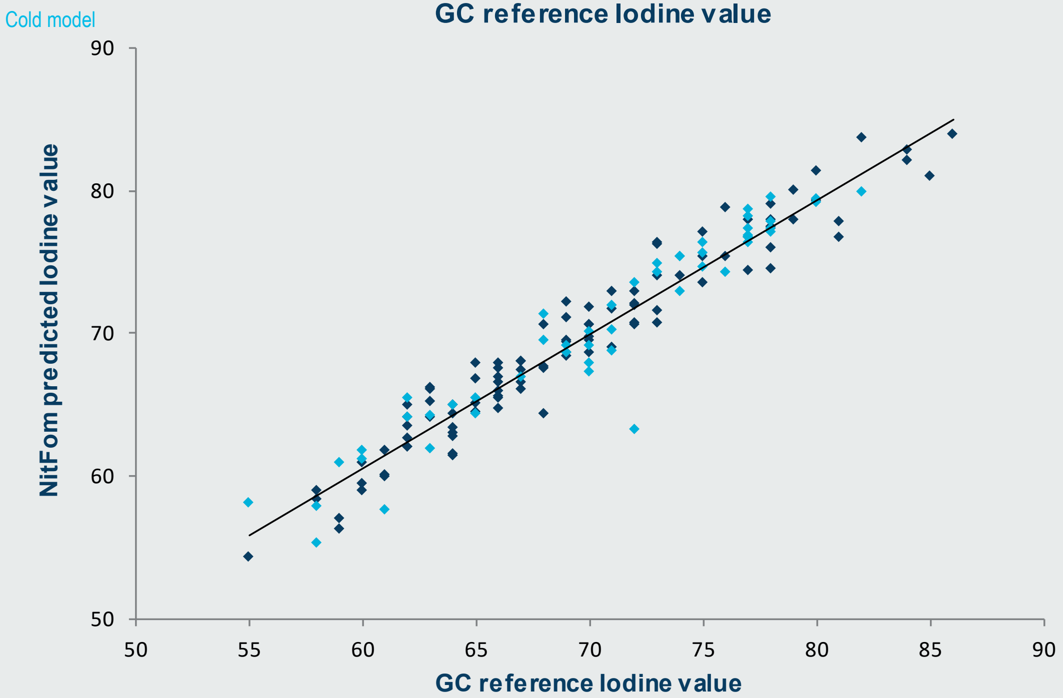
NitFom calibration

The calibration and validation study was performed in collaboration with Danish Crown (Herning, Denmark). A total of 100 pig carcasses were selected for the calibration study. The selection criteria are confidential but carcasses were selected aiming at obtaining large variations in iodine value. Approximately 30 minutes after the slaughter each carcass was measured with NitFom. The measurement was made in the neck region of the back fat next to the shoulder blade – approximately 7 cm from the split line. Samples measured on the day of slaughter (hot carcass classification) were used for developing hot calibration models. On day 1 after the slaughtering all samples were measured once more with NitFom (cold carcass classification) and included in the development of cold calibration models. References were obtained by chemical analysis (GC-FAME) at Danish Meat Research Institute at the Danish Technological Institute (Taastrup, Denmark). The iodine value was calculated from the fatty acid profile (AOCS recommended practice Cd 1c-85). The final calibration data set consisted of 100 iodine and fatty acid references each linked to a NIT spectrum allowing partial least squares (PLS) models to be developed for both hot and cold fat samples using Matlab R2013b. Six weeks after the calibration trial, 50 new carcasses were chosen for validation of the calibration models.

Prediction models

Figure 1 shows the relationship between the iodine value (IV) of hot and cold carcasses predicted by NitFom and the reference samples. A high correlation between GC reference samples and NitFom predictions in both hot (R^2=0.94) and cold (R^2=0.93) samples were found. Both models have an RMSECV of 1.8 IV. The RMSECV represents the expected variation between reference and NitFom measurement of unknown samples. An RMSECV value of 1.8 IV means that, using the calibration model, the NitFom predicted IV of hot fat samples would be predicted correctly within 3.6 iodine values (2 x RMSECV) for 95% of the samples using the NitFom fast-track method. Using the Danish IV model (hot) globally for prediction of iodine value in pigs results in a prediction error (RMSEP) around 3.5 IV.


Calibration dataset
Validation dataset
Hot model
NitFom predicted Iodine value
GC reference Iodine value
90
80
70
60
50
50 55 60 65 70 75 80 85 90

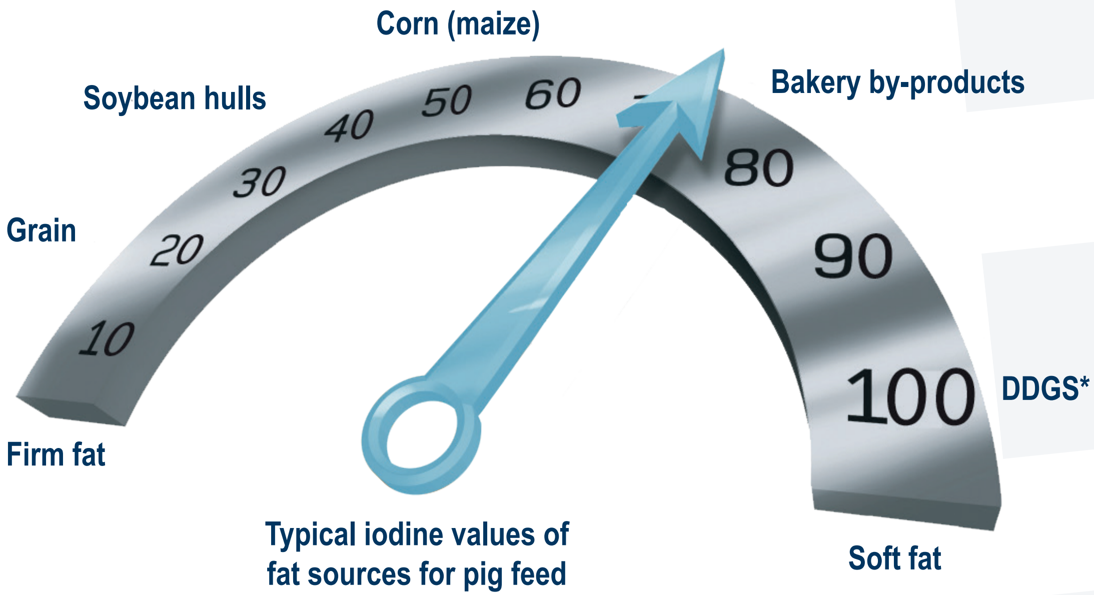

Cold model
NitFom predicted Iodine value
GC reference Iodine value
90
80
70
60
50
50 55 60 65 70 75 80 85 90

The ability of NitFom to predict individual fatty acids in Danish slaughter pigs was explored in hot fat samples (table 1). Table 1 reveals that especially polyunsaturated and saturated fatty acids are nicely predicted with the NitFom.

Due to local differences in fatty acid composition of pigs, it is generally recommended to perform local calibrations for individual fatty acids.

Conclusion

Rapid prediction of iodine value in pork fat can be performed using an on-line fast-track measuring device based on near infrared transmission spectroscopy (the NitFom). Prediction models have been developed both in hot and cold samples enabling prediction of iodine value early after slaughter and in cold samples after the carcass is split into primals.



*Distiller's dried grains with solubles

Table 1. NitFom prediction models for different fatty acids developed on Danish slaughter pigs early after slaughter

	Prediction model statistics				Reference GC statistics			
Trait	#PC	R^2cv	RMSECV (%)	RMSEP (%)	Avg (%)	Std (%)	Min (%)	Max (%)
Omega 6	2	0.91	1.2	1.1	15.6	4.00	7.8	25.2
Omega 3	2	0.73	0.4	0.5	1.70	0.76	0.6	4.0
Polyunsaturated	2	0.94	1.2	1.3	17.3	4.61	8.4	28.1
Monounsaturated	3	0.56	1.5	2.1	42.8	2.19	36.0	46.8
Saturated	2	0.82	1.5	1.4	38.9	3.43	31.3	46.4
C18:3	2	0.73	0.3	0.3	1.50	0.58	0.6	3.4
C18:2	2	0.92	1.1	1.1	14.8	3.82	7.4	23.8
C18:1 (9)	3	0.46	1.4	1.7	37.7	1.88	32.1	41.6
C18:0	2	0.66	1.0	1.1	13.6	1.67	10.3	17.4
C16:0	2	0.81	0.8	0.7	23.5	1.80	19.3	27.1

Technical data are subject to changes

FRONTMATEC

Frontmatec develops world-leading customized solutions for automation in the food industry, other hygiene sensitive industries and the utilities industry. We are especially renowned for our high-quality systems for the entire value chain of the meat industry – from carcass grading, slaughter lines, cutting and deboning lines, hygiene systems and control systems, to logistics and packaging.

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