MEAT TECHNOLOGY UPDATE
Cutting edge technology for the meat processing industry

Meat technology update

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Sampling boneless meat for chemical lean measurement

A minimum chemical lean (CL) meat specification is included in contracts written between Australian vendors of bulk-packed boneless manufacturing meat and overseas or domestic buyers.

A good system for production control of the CL content of cartoned boneless meat must be based on continuous monitoring, relying on a program of visual estimation of chemical lean backed up by regular sampling and chemical testing. Visual estimation of lean meat content remains the front-line approach for control, because slicers can immediately make appropriate adjustments to the amount of fat removed from meat to be packed to a given specification.

The visual estimates by slicers and supervisors rely upon a subjective assessment of fat levels and more attention should be given to their training in this technique. A video providing training in visual assessment of chemical lean at the point of packing is available.

Objective estimation of the CL content using on-line equipment able to estimate, non-destructively, the CL content of all meat processed is the best approach and the MQ-27 electromagnetic scanning (EMS) equipment is being used in Australian boning rooms as a method of determining the lean meat (CL) content of cold and hot boned, cartoned manufacturing meat.

Although there are other non-destructive methods, the majority of boning rooms core and test and the remainder of this Update will discuss **principles of sampling** by coring prior to preparation and testing for chemical lean determination. Further technical details on sampling and testing are available on request.

Development of a program for process control

An understanding of the elementary principles of statistics is necessary for a proper understanding of the overall procedure for selecting samples.

Frequency distribution

If the fat content of 1,000 cartons is measured it is important to understand the relevance to the plant of the values obtained. These can be displayed most descriptively in diagrams [Fig. 1(a), (b) & (c)]. If the fat content is plotted on the horizontal axis in steps of 5% and the relative number of cartons in the given group is plotted on the vertical axis, the diagrams can be produced as follows:

Calculate the relative number of cartons with a fat content of between 0% and 5%, 5% and 10%, 10% and 15%, and 15% and 20%, and draw lines at the appropriate levels on the vertical axis across between 0 and 5, 5 and 10, 10

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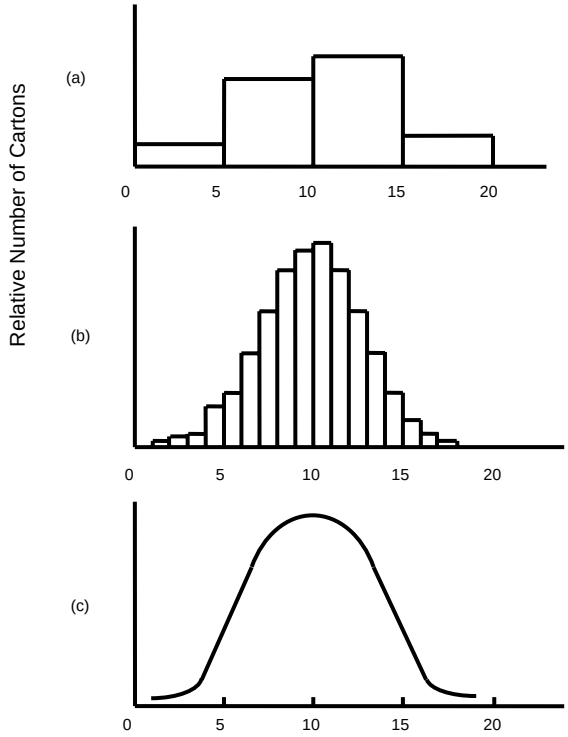
and 15, and 15 and 20, as shown in Fig. 1 (a). If now, instead of taking the intervals of 5% steps, we take intervals of 1%, diagram 1 (b) is produced. As this process is continued the diagram becomes closer and closer to a smooth curve. [1(c)].

Figure 1:



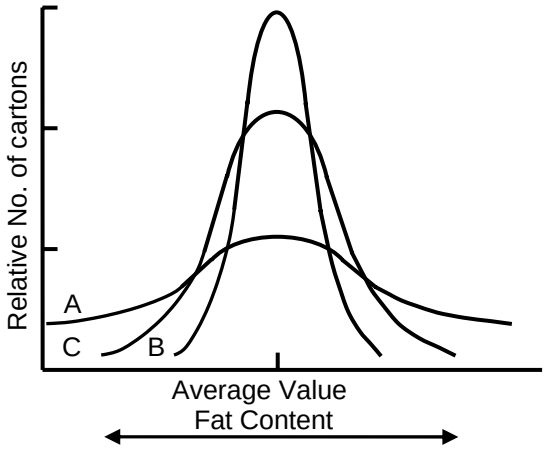
The curve shown is symmetrical and bell-shaped and is known as a normal distribution curve. From the distribution curve it can be seen that the relative number of cartons with any particular fat content can be read from the graph and further, that most of the cartons have a fat content of around the 10% mark in the example. The average is, in fact, 10% and it is now important to consider if we can describe the range of variation in the figures, and their average values.

Let us consider three theoretical normal distribution curves (Fig. 2), each prepared from the results obtained when 1,000 cartons from each of the three different works were sampled for fat content.

It is clear that all the curves have the same average value but that the spread of the results is very different. Works B is obviously doing a good job with its control of fat content, while Works A has very poor control because the range of values is very wide.

It is clear that the more the values are grouped around the average, as in case B above, the smaller is the variability and the better are the predictions made from a given number of samples.

Figure 2:

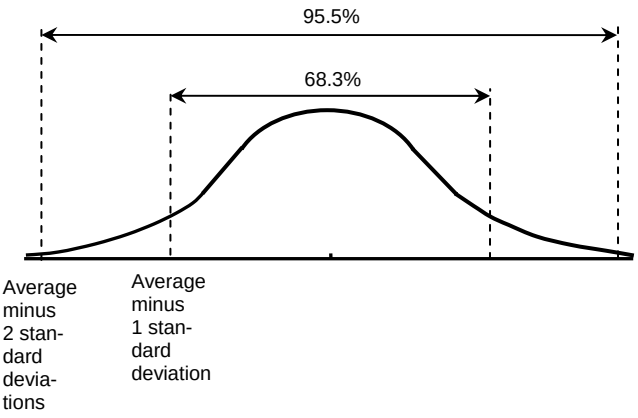


Standard Deviation

The range of values in a distribution curve can be described in terms of the standard deviation (SD). The derivation of the SD need not concern us here but its meaning can be indicated as shown in Fig. 3.

For a normal distribution it can be seen that 68.3% of the values lie within the limits: average minus one SD to average plus one SD.

Figure 3:



If the limits are extended to plus or minus two SDs, 95.5% of all values are included. Consequently, the smaller the SD, the less is the spread of results around the average and conversely, the larger the SD, the greater is the spread of the values.

In the example in Fig. 2, Works A has the largest SD and Works B the smallest.

The achievement and maintenance of a low SD is important and effective training will help bring down the SD.

Sampling prior to preparation and testing for chemical lean determination

To accurately estimate the CL of a production run of boneless meat from samples taken from the production, it is necessary to ensure that:

- samples taken from a carton are representative of the carton;
- cartons chosen for sampling are representative of the production;
- samples are prepared and homogenised so that subsamples for testing accurately represent the CL of that sample;
- testing procedures are accurate within the limits of the test.

Samples from a number of cartons can be pooled (bulked). There are guidelines available for sampling plans that can be used to sample meat from different types of production (and SD), and procedures for taking samples, preparing and testing them.

Number of cartons sampled

If cartons of boneless meat could be produced to the same precise CL specification, the samples taken from one carton from a production run would accurately represent the whole production. However, there is bound to be variation in CL between cartons in a production and several cartons have to be sampled to obtain a range of samples whose average CL reflects the average CL of the production. The more the CL varies between cartons, the more cartons should be sampled to give a good chance that the average CL of the samples matches the average CL of the production. Conversely, **the higher the degree of control over the fat content the smaller is the number of cartons required to indicate the fat content of the consignment.**

As indicated above, the variability in CL from carton to carton can be measured mathematically by calculating the carton to carton SD. From this measurement of variability, it is possible to calculate the likelihood that a certain number of samples represents a production lot within certain limits of accuracy.

Even in the best circumstances, variation between cartons is inevitable. The extent of the variation is determined by several factors. Some factors, such as the uniformity of the bone-in meat entering the boning room, close control of the packing operation, and proper training of the operators, are under the control of management. One other factor is the actual CL of the product. Variation in CL between cartons is greater for low CL product than for high CL product.

Before the required number of samples from any production lot can be determined, management must decide on the degree of accuracy required for the product concerned.

Degree of accuracy is defined in terms of:

(a) Sample accuracy

(b) Confidence limit.

The most commonly accepted sample accuracy is at least $\pm$ 1%. This means the sample result is within $\pm$ 1% of the true assessment of CL for the lot of cartons.

For CL determination, it is appropriate to define sample accuracy with confidence limits of at least 90%. This means that the chosen sample accuracy will be achieved 90% of the time. In other words, there is a 90% chance that the CL of the actual production will fall within the chosen accuracy range of the test result (it **does not** mean 90% of the samples will be right).

The greater the accuracy required, the greater the number of samples necessary from a production lot. Similarly, **the**

greater the carton variability or SD (i.e. the lower the CL), **the greater the number of samples necessary from a production lot.** Guidelines which give the number of cartons to be sampled from a lot in order to achieve any degree of accuracy for a particular carton to carton SD are available.

Note that the recommended number of cartons to be sampled applies to fresh meat during production or frozen meat in storage.

The practice of sampling a standard percentage of cartons, irrespective of lot size or SD, will not always result in an accurate assessment of CL for the production lot. When large production lots, particularly of high-CL products, are sampled at a rate of, say 5%, the results obtained are well in excess of the necessary level of accuracy. On the other hand, smaller production runs will yield results that are inadequate in terms of sample accuracy.

Conclusion

Fat sampling and analysis is time consuming and costly. It is impractical to sample and analyse all the cartons in a production lot or consignment. It is obvious that the greater the number of samples that can be analysed, the more accurately an average lean content of the total production or consignment lot can be known. It is therefore necessary to strike a compromise between accuracy and the cost of estimations. Deciding on a valid compromise requires some understanding of the statistics involved in sampling and testing for % CL.

A decision on the amount of sampling to be done depends finally on the degree of accuracy required, and the risks involved if the entire production is under-sampled. Likely significant loss incurred in 'giving away' excessive lean, or resultant claims from the supply of product containing too much fat are risk examples.

For quality assurance purposes it is important that the product is neither too lean (because the customer receives more lean meat than was paid for) nor too fat (because the customer then receives more fat than was agreed to). The latter situation, in particular, would justify a claim because the product was not to specification.

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Contact us for additional information

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