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Indigenous Electronic Instruments for Assessing Quality of Fishery Products

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Electronic Instruments play a vital role in evaluating the quality of fishery products and thereby ensuring food safety. Instruments are used for quantitative evaluation of physical parameters of fishery products. A brief account of indigenous electronic instruments developed by Central Institute of Fisheries Technology (Cochin) for measuring important parameters such as temperature, a_w, gel strength, brine concentration, and those related to dehydration of fish using solar energy are presented in this paper.

Key words: Electronic instruments, fishery products, temperature, a_w, gel strength, brine concentration, solar dehydration

Instrumentation is needed in fish processing technology at different levels for assessing and ensuring the quality during processing, making integrated watch keeping of cold storages and also facilitating new investigations in processing engineering, solar processing, etc. The quality changes in fish flesh are influenced by many factors. The most important of which is temperature. Fluctuations in storage temperature affect the shelf life stability of frozen foods leading to shorter storage stability. Hence measurement and control of temperature of freezers and cold storages are of great importance for maintaining the quality of frozen stored products. Monitoring time-temperature profile of the fish provides valuable information that can be used in application of HACCP, calculation of rate of spoilage and monitoring of product safety. Transportation of chilled foods calls for special means for maintaining temperature required for preventing deterioration of the product.

The establishment of water activity as a significant parameter in maintaining storage stability of dry and intermediate moisture food (IMF) has resulted in the need for rapid determination of this parameter. The microbial spoilage of salted and dried fish products during processing and storage also depends on their a_w. Traditional method of determining a_w is time consuming and requires elaborate and expensive instrumentation.

Deformability of food is a physical characteristic that is widely used as a measure of food quality, which influences their preference and palatability. *Surimi* is a frozen concentrate of myofibril protein of fish muscle. This fraction of muscle tissue is known to be most active in performing the functions of texture formation and binding of fat and water in many processed muscle food systems. As a quality index of *surimi*, the strength of gel has been evaluated. How a sample of food material responds under mechanical force is of interest not only to food scientists for quality evaluation but also to food engineers for design and development of food processing and handling equipment. Commercial instruments designed to test engineering materials are generally costly. Hence a low cost testing instrument has been designed for this purpose.

Dehydration process meets the objective of preserving the products during prolonged storage by reducing the moisture content of the product to levels, which are adequate to limit growth of microorganism or other chemical reactions. In addition, reduction in moisture content results in preservation of quality characteristics such as flavor and nutritive value. Another objective of dehydration is significant reduction in product volume, which promotes efficiency in both transportation and storage of important food products. Solar energy is used for processing of food products by dehydration. Though it is a traditional method, solar drying has now been improved on scientific basis, in order to derive wholesome dried fish products.

Blanching is one of the most important steps in canning of prawns, to bring down the moisture of the product to the required level, coagulate proteins and to provide proper texture, shape and characteristic colour to the meat. The usual method of salt estimation by analytical method is time consuming. An instrument for instantaneous determination of brine concentration has been developed for this purpose.

Indigenous electronic instruments developed at Central Institute of Fisheries Technology (Cochin) for monitoring important parameters for assessing and ensuring the quality of fishery products are presented this paper.

Freezer Temperature Monitor

The instrument (Fig.1) was developed for continuous monitoring of temperature inside cold storages and deep freezers ranging from -40°C to

+40°C with special features such as (i) mini sensor of size 2.5 mm dia, 10 mm length with thin cable to monitor the temperature inside the fish blocks, (ii) thin connecting cable of 1mm diameter, enabling easy insertion of the probe through the door gaps of freezers and cold storages without disturbing the equipment, (iii) wire telemetry measurements with long cable up to hundreds of meters, (iv) recording and printing facility, (v) alarm signals when the temperature deviates from a required preset temperature range and (vi) digital display of the data.

Fig. 1. Multi-channel Freezer Temperature Monitor

Multi channel freezer temperature monitor is another model with automatic operation facility for simultaneous measurement of temperature in the range -40°C to +40°C from different locations inside plant or different positions of fish block using several sensors installed at different locations enabling (i) detailed studies on the operational characteristics of the plant (ii) estimating the efficiency/defects of existing plants (iii) temperature distribution features of plants (iv) location of temperature leak points of plants (v) efficiency of insulating materials used in the plant and (vi) temperature penetration characteristic of different food products. Remote display of temperature is an advantage over conventional thermometers. The instrument can be operated in manual/automatic mode with facility for printing the data/ recording/storing the data using memory device. Alarm facility when the temperature deviates from the preset value and digital display are other features.

Water Activity Meter

The instrument (Fig.2) measures water activity (a_w) (0.40 to 0.95±0.01) of food samples kept inside a tight enclosure and temperature of the environment inside the enclosure (0-100°C). This is a measure of free water actually available in food systems to react chemically or to support the growth of microorganism such as bacteria or mould. The salient features of the

instrument are quick and accurate measurement, easy operation, digital data display, low cost, low power requirements and portability.

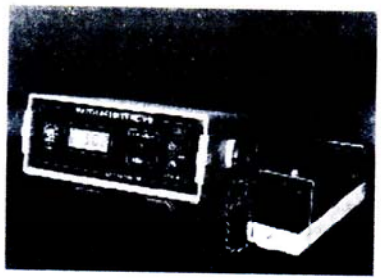

Fig. 2. Water Activity Meter

Rheometer

This instrument (Fig.3) was developed for finding the breaking strength of gels (*surimi* and sausages) (0-500 g) and deformation (0-20 mm) of the sample under pressure with facility for recording the data in a strip chart recorder. A motor control is used for rising and lowering a plunger sensor, to compress the sample under test. A spherical plunger having 5 mm dia is used for compressing the samples (25 mm long). Gel strength is calculated as the product of breaking strength and deformation (g.cm). The salient features of the instrument are digital display with accuracy of ±0.1g, recording facility, and low power requirement.

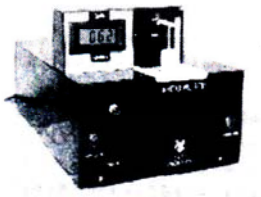

Fig. 3. Rheometer and a typical force-time curve

Solar Processing Monitor

This electronic instrument (Fig. 4) was developed for facilitating systematic studies on the effect of solar radiation and relevant environmental parameters on fish during solar and tunnel dehydration processing of fishery products. The instrument consists of remote operated sensors which sense the respective parameters and transmit the signals to a central place and an

electronic unit where the signals are conditioned, processed and displayed in a digital meter with provision to feed the data to an external printer or recorder. The system can be operated manually or automatically, scanning the remote operated sensors and displaying the data one by one. The system indicates the following parameters:

Solar radiation	:	0-1400±5 watt.m^{-2}
Wind velocity	:	0-100 km.h^{-1}±1%
Relative humidity	:	0-100%±1%
Air temperature	:	0-80±0.1°C
Fish moisture	:	0-40%±0.1%
Water evaporation	:	0-40±0.1 mm
Weight loss of the product	:	0-500±1 g

Special features and advantages of the equipment are remote operated sensors enabling centralized monitoring, integration of wind and solar energy indicating their respective total values over long duration, recording facility and flexibility to accommodate any number of parameters as required.

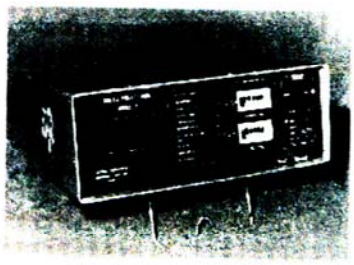

Fig. 4. Solar Processing Monitor

Brine Concentration Meter

The instrument indicates the concentration of brine in blanching tanks by means of a sensor mounted at the side of the blanching tank and the meter mounted close to the tank thus eliminating manual effort and errors involved in the measurements. The range of the equipment is 0-12±0.5%. The special features are quick and accurate measurement of brine concentration during blanching without disturbing the routine blanching operation and digital display of data. The sensor made of platinum electrodes and fused to glass can withstand very high temperature.

All the instruments work at 9V DC supply by built in power supply operating from 230V AC. The instruments developed have been extensively used for research and field application and have been found extremely useful for the purpose for which they are developed. The small size temperature sensor attached with thin cable enables measurement from small objects such as individual fish and fish blocks, fish under processing, etc. The automatic recording and printing of data in real time, help to keep record of the history of processing and storage. The measurement of a_w using Water Activity Meter is important in many phases of food processing. The basic design of Rheometer with modifications can be utilized for physical tests on different types of foods.

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