

Electronic Instruments for Application in Fish Processing

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Working principles and salient features of sensors and electronic instruments, Water activity meter and Gel strength tester, developed in CIFT for applications in fish processing are described. A brief description of other related instruments with particular reference to the improvements and additional features incorporated is also presented.

Key words: Instruments, fish processing

Research and development in fish processing necessitates instrumentation at different stages for assessing quality of fish as well as monitoring and evaluation of processes. Rao (1968) and Sivadas (1978) used thermistor-based monitors while Ramakrishnan *et. al.* (1982) used both thermistor and transistor p-n junctions for measurement of temperature in frozen stores.

Many of the instrument needs in fish processing are now met in India by import. Measurement of water activity (a_w) is an important need in studies particularly related to dried and salted products. Gel strength is a very important factor deciding the quality of products like surimi. Monitoring of several parameters in drying is necessary to decide the most appropriate levels in drying fish. Determination of the concentration of salt in the brining system while in operation is an important need in canning shrimp. Hydrometer gives only an approximate measurement and chemical methods are time consuming. An instrument for determination of the concentration of brine instantaneously on the spot is an important need in this process. Indigenous development and working principles of few electronic equipment developed for application in the above fields are presented in this paper.

Water Activity Meter

This instrument was developed to measure water activity in dry/cured fish. Most of the hygroscopic materials undergo dimensional change with change in humidity. This property is made use of in measuring equilibrium relative humidity (ERH). The instrument consists of a sensor and an electronic display meter. Dry fish sample is kept inside an air tight chamber and the saturated vapour pressure of water in the air after attaining equilibrium with the sample is measured as a_w of the sample. The instrument was calibrated using standard salt solutions of known ERH at constant temperature.

Performance evaluation of the instrument and sensor was made to assess the accuracy and reliability. ERH of different types of dried fish samples with different

moisture contents were studied and compared with values obtained with the instrument developed. a_w was also evaluated by Wink's weight equilibrium method and also using an imported a_w meter. The results are given in Table 1.

Table 1. a_w determined by different methods

Sample	Moisture, %	a_w values		
		Wink's method	CIFT meter	Imported meter
Anchoviella, salted	13.98	0.63	0.64	0.64
Barracuda, salted	52.55	0.75	0.74	0.76
Lactarius, salted	40.22	0.75	0.75	0.76
Silver belly, salted	51.88	0.762	0.75	0.77
Dry sole, salted	48.62	0.748	0.75	0.76
Jew fish, dry	20.33	0.81	0.81	0.82
Mackerel, salted	52.40	0.735	0.75	0.74

Gel Strength Tester

Gel strength tester measures the force required to shear gel type food materials and its deformation before break. The data are recorded in a strip chart recorder. The force is recorded with time for the entire period for which the force is exerted on the sample. The technique of inductive pick-up is used for measuring gel strength and the deformation of the sample. Gel strength is given by load (rate of deformation (g x cm)).

A test piece of gelled fish meat, about 25 mm thick and 30 mm dia, is placed under a plunger with a convex head of diameter 5 mm. By applying pressure into the surface of the sample with the plunger, the test material is gradually deformed and ultimately broken. The curve obtained indicate not only the gel strength as measured by a peak force value but also deformation as measured by the distance from initiation of the curve to the first peak.

Freezer Temperature Monitor

The base emitter junction voltage of a semiconductor varies linearly with temperature. This property of semi-conductor is made use of for temperature measurement. This instrument was designed to record temperature of cold storage/freezers/fish blocks. The instrument developed earlier was modified by incorporating facility for continuous recording of the data. Different designs of sensors were also developed for various applications. The instrument is provided with alarm facility when the temperature fluctuates from the required range. The instrument is available in different designs which include automatic type with facility for storing the data in memory module/computer with real time and other details such as name of instrument, place of operation etc.

Multichannel freezer temperature monitor is an improved model developed for simultaneous measurement of temperature from different locations inside a plant or different positions of fish block enabling (a) detailed studies on the operational

characteristics of the plant (b) estimating the efficiency/defects of existing plants (c) temperature distribution features of plants (d) location of temperature leak points of plants (e) efficiency of insulating materials used in the plant and (f) temperature penetration characteristics of different food products.

Solar Processing Monitor

This instrument was developed for facilitating systematic studies on the effect of solar radiation and relevant environmental parameters in fish during sun drying. The instrument consists of a set of remote operated sensors which sense the respective parameters and transmit the signals to the display meter where the signals are conditioned, processed and displayed one by one along with provision to feed the data to external printer/recorder/storage devices. The system works automatically, scanning the remote operated sensors and displays the data taking 11x10 seconds for one cycle of operation. The parameters monitored are solar radiation, wind velocity, relative humidity, air temperature, water evaporation and physical changes in the fish during dehydration namely weight loss and moisture level. Solar and wind energies are integrated continuously, indicating their total energy values for long duration of days or weeks that are responsible for drying. The electronic processor included gives the accumulated energy incident over unit area to give total energy in Watts/m².

Brine Concentration Meter

This meter helps in continuous measurement of concentration of brine in the range 0 to 12% during blanching without disturbing the routine operation. The instrument consists of a platinum conductivity cell designed to operate at the required high temperature and an electronic display meter. The sensor can be mounted outside the blanching tank with inlet and outlet connected for the salt solution to circulate through the transducer tube. The sensor can also be mounted temporarily inside the blanching tank as and when the measurements are required.

The instruments developed have been extensively used for research and field applications and have been found extremely useful for the purposes for which they are developed. The small size temperature sensor attached with thin teflon cable enables measurements from small objects such as fish blocks, fish under processing etc. along with remote measurement using long cable. The automatic recording or print out data with real time helps to keep record on the history of processing and storage.

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