ACTA ICHTHYOLOGICA ET PISCATORIA

Vol. V, Fasc. 1 Szczecin, 1975

Tadeusz KAWKA, Andrzej KOLBIARZ

Fish processing

FISH GUTTING WITH THE STREAM OF WATER

PATROSZENIE RYB ZA POMOCĄ STRUMIENIA WODY

Institute of Marine Food Technology

INTRODUCTION

The universalisation of the technical equipment especially the gutting and filleting machines, is one of the important trends in the industrial fish processing.

Due to the specific conditions of work and high technological requirements as far as the fish processing is concerned the design of such machines is very difficult. Not an unimportant factor is the economic one which demands the maximal utilisation of the raw material for consumption purposes. The average output of the universal equipment is always less than that of the specialistic equipment.

The universalisation of equipment imposes the necessity to compromise in frequently conflicting requirements concerning the processing machines.

The contemporary equipment is adjusted to processing various species of fish in specific ranges of size. It results among others from the working arrangements based on mechanical problems which are traditionally used in the construction of the processing machines. The kinetics of mechanisms in turn imposes a narrow specialisation as far as the possibility of the design of equipment is concerned. Aiming at the universal utilisation of the machines the usage of the mechanical arrangements is possible, but extension of their work range must be compensated by the simplification of the technological scheme of the processing.

The present needs and directions of the fish processing machines development necessitate the search for new ways and possibilities based on hydraulic or pneumatic principles. It is rather difficult to forecast the way the research concerning the further development of processing machines design will take.

While the usage of underpressure for fish gutting has been known for a long time and successfully used in small fish gutting machines, the research of hydrodynamic gutting has only recently been undertaken.

Čivilenko (1963) was the first to attmept gutting with the stream of water. Čeprasov (1970) pointed out the high water consumption in this method. In his theoretical investigation he aimed at defining the executed operation in terms of a ratio which would comprise both technical and economic factors of work with the stream of water. Čeprasov assumed that the proportion of the volume of used water to the amount of entrails washed out can be the numeral parameter (λ) indicating the effectivness of the operation.

During the fish gutting with the stream of water, efficiency of the process depends on a number of factors conditioned equally by both properties of the processed raw material and the stream parameters. Thus, allowing for certain limitations, λ coefficient can be characteristic of the executed gutting operation.

METHODS

Appreciating the possibility of using the hydraulic method of removing the entrails from fish and also seeking the way to decrease the unitary water consumption, experiments were carried out with the stream of water mixed with compressed air.

The objective was to establish the optimal stream parameters, i.e. pressure and amount of water necessary to wash out the entrails from the fish abdomen.

The experiments were carried out on the fresh Baltic cod (*Gadus morhua callarias* L.) and on the fresh herring (*Clupea harengus* L.).

The equipment for producing the water and air stream comprised pipes conveying the respective elements, a mixer and exchangeable end-pieces producing the stream (Fig. 1). The pipes were fitted with pressure gauges and regulating valves.

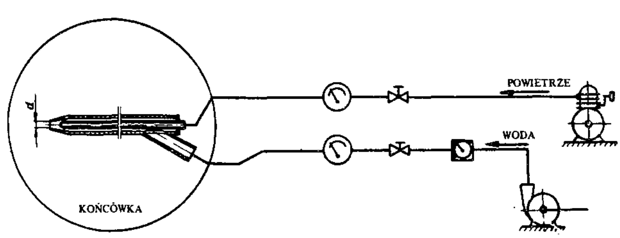

Fig. 1 – The experimental installation scheme
końcówka – end-piece
powietrze – air
woda – water

The effect of the stream directed at the entrails of a headless fish with the unlacerated abdomen was observed. In order to achieve the optimal positioning various angular arrangements of the stream towards the body of the fish were used.

RESULTS

In accordance with the hydrodynamic laws, the effect of the stream increases with the increase in the kinetic energy of the stream outflowing from the end-piece.

The amount of outflowing liquid depends on the diameter of the outlet and pressure, so it can be formulated thus:

$$Q = \mu \cdot F \cdot \sqrt{2 \cdot g \cdot H}$$

where:

μ = is the stream outflow coefficient (established empirically),
F = is the diameter of the outflow,
g = is the acceleration of gravity,
H = is the pressure in the mixer (in meter of the column of water).

The impact force of the water and air stream changes along its way. The length of "working" section of the stream depends on the outlet area and pressure. This length increases with the increase of the outlet diameter. The increase of pressure however, can produce the opposite result.

The effectiveness of removing the entrails from the fish abdomen is thus not proportional to the pressure. This is caused by the stream loosening in the air. The danger of the loss of effectiveness of the stream lies in a probability of the excessive pulverisation of water, which in turn, involves the great loss of energy. At the same time, the cavitation increased by decompression of air bubbles occurs at the outlet. This causes the interruption in continuity of the stream. Thus, the distance between the outlet and the point of action of the stream should be as short as possible. However, this does not mean that the best effect is to be achieved with a continuous stream. The percussive effect of water in form of large drops moving under the influence of the compressed air considerably shortens the time of the operation, particularly the time of removal of the peritoneum.

The experiments carried out proved the utility of the water and air mixture in the hydrodynamic fish gutting. As far as the quality of cleaning was concerned the parity in results of the usage of the water and air stream in comparison with the water stream was ascertained. Simultaneously, the water consumption was decreased by 30 to 40% on average, depending on the outlet diameter.

Satisfactory effects of gutting were obtained for small fish (herrings) at the pressure of $5 \cdot 10^5 N/m^2$ for air and $3 \cdot 10^5$ N/m^2 for water, with the outlet diameter ϕ of 0.006 m.

Good results were obtained also with the selfsuction end-piece (Fig. 2). The considerable increase of the stream continuity was obtained at the working pressure of $3 \cdot 10^5$ N/m^2 (the dimensions of the end-piece see Fig. 2). Conveying of the air in this end-piece was based on the principle of the underpressure developing in its neck. This solution provided a good efficiency of the stream and simultaneously eliminated the compressed air system.

The effects were unsatisfactory in case ot gutting fish longer than 0.5 m. Inaccurate separation of entrails from the anal opening occured in a large number of fish. It was possible to achieve good results previously mechanically cutting out the anal joint.

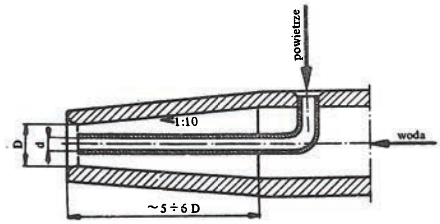

Fig. 2 – Self-suction outlet

REFERENCES

Čivilenko V.P., 1963: Nekotoryje parametry mehanizacii rozdelki melkogo častika. Trudy KaspNIRO, XIX.

Čeprasov N.N., 1970: O vybore harakteristiki i metodiki isledovanija processa gidroudalenija vnutrennostej ryby pri ich razdelke. Trudy KalTIRP, XXXVI.

Translated: mgr Jerzy Dmochowski.

PATROSZENIE RYB ZA POMOCĄ STRUMIENIA WODY

Streszczenie

Badania nad sposobem hydrodynamicznego oczyszczania ryb z wnętrzności, wynikają z aktualnych potrzeb posiadania bardziej uniwersalnych urządzeń niż dotychczas budowane maszyny przetwórcze.

Badania przeprowadzono z dwoma różnie skonstruowanymi końcówkami, do których doprowadzano wodę i powietrze. Próby dowiodły celowości stosowania strugi wodno-powietrznej. Dobre wyniki osiągnięto przy patroszeniu małych ryb, stosując ciśnienie $3 \cdot 10^5$ N/m^2 dla wody i $5 \cdot 10^5$ N/m^2 dla powietrza, średnica otworu wylotowego 0,006 m.

ПРОБЛЕМА УНИВЕРСАЛИЗАЦИИ МАШИН ДЛЯ ОБРАБОТКИ РЫБЫ

Р е з ю м е

Необходимость проведения исследований над способом гидродинамического очищения рыб от внутренностей делает актуальными потребности в более универсальных устройствах, чем производимые до сих пор перерабатывающие машины.

Исследования проводились с двумя по-разному сконструированными посадками, к которым подводили воду и воздух. Испытания показали целесообразность применения воздушно-водной струи. Положительные результаты получены при потрошении мелкой рыбы с применением давления $3 \cdot 10^5$ N/м^2 для воды и $5 \cdot 10^5$ N/м^2 для воздуха; диаметр выходного отверстия – 0,006 м.

Address:

Received: 26 V 1974 r.

Dr Tadeusz Kawka, mgr Andrzej Kolbiarz
Instytut Technologii Żywności
Pochodzenia Morskiego AR
71-550 Szczecin, ul. Kazimierza Królewicza 4
Polska – Poland