MFR PAPER 1079

NMFS scientists have devised a simple method for . . .

Controlling Bone Particle Content in Minced Fish Muscle

MAX PATASHNIK, DAVID MIYAUCHI, and GEORGE KUDO

ABSTRACT—Minced fish muscle recovered by flesh separators or deboners may contain some bone particles. The amount depends on the size of the final extrusion opening that the fish are pressed through, the type of equipment and its adjustment, and the species or type of fish material used. Monitoring the bone content is important since it affects the end use of the product. A simple, rapid method for quantifying the bone content is presented. It involves (1) shredding the flesh with a low-speed stirrer and (2) gravity-separation of the bone and other high density components from the floatable muscle fibers with water. The method may serve as a useful quality control tool for the producer and user of minced flesh.

INTRODUCTION

In recent years, the production of frozen blocks from minced fish muscle has risen sharply. Minced fish muscle obtained from either dressed fish or the trimmings and frames of the various processed species by flesh-separating machines may contain bone particles. The frequency of occurrence of particles depends largely on the size of the final extrusion opening through which the minced muscle is passed. Short pieces may appear in the minced muscle when bones are aligned transversely across the extrusion opening and are sheared off and forced through the opening by belt pressure. Longer pieces of bone may appear when, by chance, they are aligned axially with the extrusion openings and are passed through before being sheared off. Bone particles may be hard or they may be soft and pliable according to the species. The frequency of occurrence of particles may also vary with the type of the flesh-separating equipment and its adjustment, the type of material being processed, and the fish species.

Controlling the bone particle content of minced fish flesh is important in relation to its end use. Fish-stick or portion-type products are heated for a short period of time. Bones do not soften and they may be apparent in the cooked product. In sterilized, canned-type products, where bone-softening is usually assured, the bone content is not critical. Most minced flesh used today is in the first category. Bone content control therefore is of importance in relation to quality criteria and consumer acceptance. In recognition of this, the National Marine Fisheries Service "Proposed U.S. Standards for Grades of Minced Fish Blocks" cites bone particle content as an important quality attribute.

Both the producer and the industrial user of minced fish flesh need a simple method for quantifying bone content in order to determine end product quality and to verify compliance with buying specifications. Various methods of determining the bone content have been considered. Subjective sensory procedures involving visual and finger-feel location of bones were found to be unreliable. Procedures involving enzymatic digestion of the protein as a means of bone separation were time-consuming, as was chemical determination of calcium. An objective gravity-flotation procedure was found to meet the criteria of simplicity, speed, and reproducibility. The purpose of this report is to: (1) present the details of this method for assessing the bone content in minced flesh; and (2) discuss its use.

Max Patashnik, David Miyauchi, and George Kudo are members of the staff of the Pacific Fishery Products Technology Center, National Marine Fisheries Service, NOAA, Seattle, WA 98112.

GRAVITY-FLOTATION METHOD FOR DETERMINING BONE CONTENT

The method involves two steps: (1) shredding the flesh with a low-speed stirring device; and (2) gravity-separation of the bone, cartilage, and other high-density components from the lower-density muscle fibers.

Equipment.—(1) 8-speed food stirrer-blender-disintegrator (Oster Model 847[1] or equivalent) with cutting edges of the blades blunted or rounded; (2) 5-cup blender jar; (3) shallow pan; (4) timer; and (5) absorbent paper.

Procedure.—(1) Weigh ¼-lb of fish sample, which may be either frozen or unfrozen; (2) place sample in 5-cup blender jar and fill with cold tap water; (3) blend at lowest speed for about 2 minutes; (4) place blender jar inside a shallow pan set in sink and run tap water into it at a flow rate of about 1 gallon/minute until water is essentially free of floating fish muscle fibers; break up any remaining aggregates of flesh at the bottom of the jar or on cutter blade or pan, and float off fibers with running water; (5) transfer quantitatively the bone, fin, and cartilage residue to absorbent paper for estimating or counting, (6) for counting, separate into components (bones, cartilage, scales, skin

[1] Reference to trade name does not imply endorsement by National Marine Fisheries Service, NOAA.

pieces, etc.); and (7) sort bones into various categories as follows:

Soft, pliable bones	
$<1/4$"	$\geq 1/4$"

Hard, rigid bones	
$<1/4$"	$\geq 1/4$"

Then count number of bones and report as number per pound. (Bone counts below 10 per ¼-pound are counted and those above are reported as >10. A hard, rigid bone is one that leaves a clear indentation when pressed axially between the fingers.)

The above size categories and method of reporting bones are mainly for potential use in preparing the "Proposed U.S. Standards for Grades of Minced Fish Blocks." In practice, the method for reporting bones and other non-muscle components will depend upon product specification requirements or the type of quality information needed by the buyer or seller of the products.

To determine the reproducibility of the procedure and to insure that bones are not being reduced in size during blending, the following test is suggested: (1) add 10-20 bones of known size to a bone-free sample of minced fillet flesh; (2) run through the above procedure to determine if all bones are recovered and if there is bone fragmentation; (3) repeat as required to assure reproducibility of the procedure. If fragmentation does occur, it may be due to inadequately blunted or rounded blender blades.

Larger size samples of about 1 pound can be evaluated by using a 1-gallon blender. The cutter blades may be non-destructively rounded by slipping a piece of rubber or plastic tubing over each blade. The general procedure is similar to that for the smaller size samples.

CONTROL OF BONE PARTICLE CONTENT AND USE OF GRAVITY-FLOTATION METHOD

The gravity-flotation method is recommended as a useful quality control tool to provide reasonably accurate estimates of bone particle content for the producer, industrial user, and inspector of frozen and unfrozen minced muscle. For example, it may be used to monitor the bone content of minced flesh from bone-separating equipment for the purpose of optimizing machine adjustments so as to obtain maximum flesh yields while meeting bone content and other quality limitations for end use of the product. Minced flesh is usually obtained from bone-separating equipment operating with extrusion openings of from 1 to 7 mm. The size of the opening and the machine adjustment control the quantity and type of bone passing through with the minced flesh. This in turn determines how the flesh can be used. Thus, the use of minced flesh in fish-stick or portion-type products will undoubtedly set a limit on the number of hard bones permitted in a pound of product. Meeting such a limit may be accomplished by machine adjustment, straining of the flesh, or by dilution of coarse minced flesh with strained flesh. The use of the minced flesh of some species in spreads, snacks, or sausage-type products may require their final straining through 1- to 2-mm strainers to obtain maximum reduction in detectable bones (Patashnik et al., 1974). In heat-sterilized, canned products such as those prepared from salmon trimmings, the flesh-separating equipment can be adjusted to give maximum yields despite the resultant high bone contents since the thermal process is adequate to soften the bones.

The method can also be used to concentrate scales, fins, vertebral bones, and other debris to permit their quantitative assessment as an indication of product quality and workmanship. For example, high scale content of some commercial products indicates poor washing practices.

Inasmuch as particle size affects the product's chewability or texture, it is often useful to know whether the minced flesh is essentially fine or course or a mixture thereof. During the *first few seconds* of blending (step 3 under Procedure), the relative proportion of coarse and finely minced flesh in the product may be visually estimated. Also, if there are any off-color defects in the product, they can be readily observed during the blending.

In summary, the method is flexible in that it offers the choice of obtaining accurate bone particle counts or of making rapid visual estimates according to the needs of the user. Where only an estimate of the type and quantity of bones, scales, fins, skin, and other non-muscle debris is needed for quality control screening, the procedure may be speeded up and the various extraneous materials may be visually estimated rather than counted. A test may take from a few minutes per sample up to several minutes, depending on the accuracy desired.

In the preliminary examination of frozen minced blocks, one can rapidly determine if a bone problem exists by cutting off sample slices by knife or saw. These may be placed under running tap water and lightly surface-thawed. By running the finger across the surface, one can detect the presence or absence of significant amounts of bone protruding through the soft, thawed surface. This preliminary examination can often determine the magnitude of the bone incidence and the need for further testing by the above described method. For field examination where a blender is not available, this simplified approach may provide a crude estimate of the presence or absence of significant quantities of bone in the product.

LITERATURE CITED

Patashnik, M., G. Kudo, and D. Miyauchi. 1974. Bone particle content of some minced fish muscle products. J. Food Sci. 39:588-591.

MFR Paper 1079. From Marine Fisheries Review, *Vol. 36, No. 8, August 1974. Copies of this paper, in limited numbers, are available from D83, Technical Information Division, Environmental Science Information Center, NOAA, Washington, DC 20235.*