

# Development of Value-Added Food From Trout



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## ABSTRACT

While protein solubility was highest at pH 2.0-3.0 and 12.0-13.0, the precipitation was highest at pH=5.5. Protein recovery yields were between 80-90% for 2.0<pH<3.0 and 75-85% for 12.0<pH<13.0. The  $\omega$ -3 and  $\omega$ -6 FA were slightly degraded by 2.0<pH<3.0 and 12.0<pH<13.0. The texture profile analysis (TPA) and Kramer cell showed that gels were very firm; with high gumminess and chewiness values.

## INTRODUCTION

Filleting fish requires removal of bones, skin, head, and viscera (hereinafter called by-products). Most processors fillet fish by mechanical means. Mechanical filleting of 100 lbs of trout or tilapia yields approximately 40 or 30 lbs of fillets and 60 or 70 lbs of by-products, respectively. The 60-70 lbs of by-products contains approximately 20-23 lbs of un-recovered fish meat and 5-7 lbs of un-recovered fish lipids. The by-products are reduced to compost, animal feed, or landfilled. In descriptive terms, per two truckloads of trout fillets going to the market, one truckload of trout meat un-recovered from by-products and a quarter of a truckload of trout lipids un-recovered from by-products are reduced to compost or animal feed.

The growth of the aquaculture industry necessitates development of technologies that recover proteins and lipids from filleting by-products and increase the total return. The use of recovered proteins and lipids for human food instead of for compost or animal feed will increase the value of these materials. Therefore, human food products developed using proteins and lipids recovered from by-products will be referred to hereinafter as value-added food products. The aim of this research is development of the following two value-added food products: (1) surimi seafood (i.e., imitation crabmeat) using the proteins recovered from by-products and (2) fish oil using the lipids recovered from by-products.

Value-added human food products developed from by-products will enable the aquaculture industry to diversify its product offerings. Seventy-five percent of the Fortune 500 CEOs indicated product diversification as the number-one strategy for the 21st century. Creation of edible products from by-products may lead to development of niche markets. The niche markets would increase profitability of the regional aquaculture industry. Recovery of proteins and lipids from by-products will result in more efficient use of available natural resources. This research will directly benefit the West Virginia's aquaculture industry and West Virginia University.

## OBJECTIVE

Our objectives were to determine: (1) solubility of myofibrillar and sarcoplasmic proteins as a function of pH and ionic strength (IS); (2) protein and lipid recovery yields; (3) fatty acid profile (FAP) of recovered lipids; (4) texture and color of gels developed from recovered proteins.

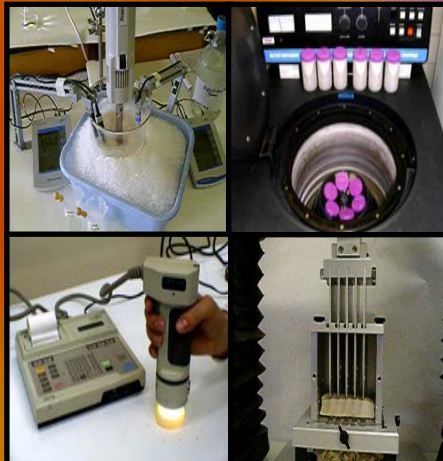
## MATERIALS AND METHODS

The project has been divided in two phases: (A) development of pH-driven protein recovery from by-products, and (B) development of value-added food from recovered proteins and lipids.



During phase A, the following was determined: (1) solubility of myofibrillar and sarcoplasmic proteins from pH 1.5 to 13.0 using the Bradford method; (2) protein and lipid recovery yields based on the protein solubility characteristics; (3) fatty acid profile (FAP) of recovered fish lipids using methyl ester derivatives and gas chromatography (GC).

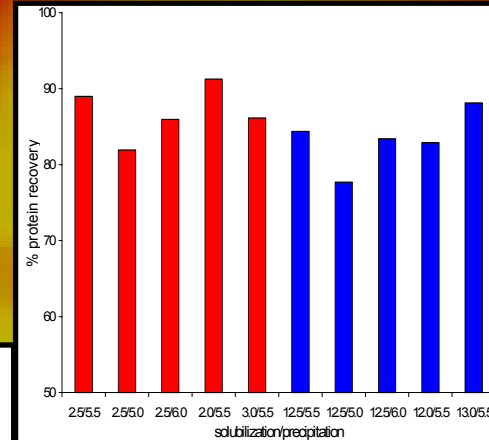
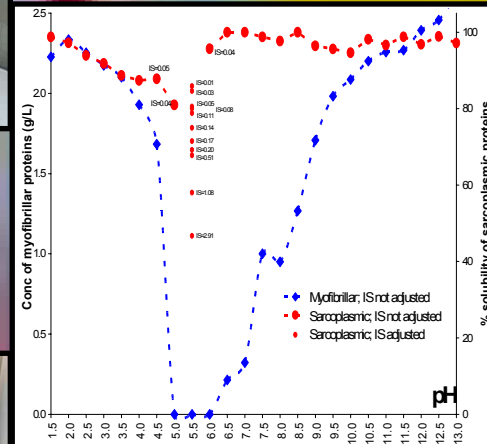
During phase B, the following was carried out: (1) development of protein gels from recovered proteins; (2) texture and color determination of the protein gels using Kramer cell and texture profile analysis (TPA), and color L\* a\* b\*.



## RESULTS AND DISCUSSION

Solubility studies showed best solubility of trout myofibrillar and sarcoplasmic proteins in two pH ranges; acidic pH = 2.5 and basic pH = 12.5. Precipitation of myofibrillar and sarcoplasmic proteins was highest at pH = 5.5. Sarcoplasmic proteins unlike myofibrillar proteins are water soluble. Precipitation of sarcoplasmic proteins was enhanced by higher ionic strength (IS). Higher IS shifted peak precipitation of myofibrillar proteins to pH = 4.5.

Based on trout muscle protein solubility characteristics, a laboratory scale protein recovery batch process was designed and tested for recovery yields at various pH conditions. A trout sample was (1) homogenized, (2) solubilized at acidic or basic pH, (3) protein-rich solution was separated from oil and insoluble fraction by centrifugation, (4) the protein-rich solution was precipitated at isoelectric point, and (5) water was separated from muscle protein pellet by centrifugation. Protein recovery yields were slightly higher at acidic pH range, approaching 90%. Protein recovery at basic pH was generally above 80%.



Fatty acid profile (FAP) of trout muscle and the trout lipids recovered at pH = 2.0, 2.5, 3.0, 12.0, 12.5, and 13.0 was analyzed to determine quality of FA. The concentration of the  $\omega$ -3 and  $\omega$ -6 FA in the recovered lipids was generally 3 times higher than in trout muscle. The concentration of linolenic (18:3n3), EPA (20:5n3), DHA (22:6n3), linoleic (18:2n6), and arachidonic (20:4n6) in the recovered lipids was generally 5, 4, 3, 3, and 3 times higher than in trout muscle, respectively.

The recovered proteins were chopped, mixed with ice and salt, and then cooked at 90°C for 15 minutes. Developed gels were used to determine texture and color properties of trout muscle proteins in comparison to highest grade commercial Alaska Pollack surimi. The gels obtained from trout exhibited superior gel strength, however, they were more yellow (higher b\*) than gels obtained from Alaska Pollack surimi.

