



# QSAR-Aided Study Of Antihypertensive Peptides From Egg

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## SUMMARY

Hypertension or high blood pressure is a well-defined risk for cardiovascular diseases. Bioactive peptides (short fragments of proteins) that inhibit the activity of angiotensin converting enzyme (ACE) could lower high blood pressure.

To develop the most potent peptides from egg proteins, an integrated quantitative structure activity relationship (QSAR) and bioinformatics approach was developed in the study to replace the conventional one protein-one enzyme approach. Furthermore, three new peptides (IRW, IQW and LKP) were predicted as the most potent. We were able to produce these peptides after digestion of egg white protein, Ovotransferrin; the peptides may have applications in prevention and treatment of hypertension.

## PROBLEM

Hypertension is one of the major causes of mortality in the world, afflicting 27.6% population in North America and 44.2% in Europe.

Bioactive peptide derived from different proteins showed ACE inhibitory activity and can be potentially used as a component in functional foods or nutraceuticals for the treatment of hypertension.

Various ACE inhibitory peptides have been reported but production of the most potent ACE inhibitory peptides from food proteins remains a challenge due to a lack of understanding the structure and activity relationships of peptides.

Further understanding the structural complexities of ACE inhibitory peptides through QSAR study could therefore help us to produce ACE inhibitory peptides with improved activity.

## OUR APPROACH

Angiotensin-Converting Enzyme (ACE) functions in the renin-angiotensin cycle to increase blood pressure. So, the inhibition of ACE is the therapeutic way for the treatment and prevention of hypertension.

Major egg white and yolk protein sequences were retrieved from public database (ExPASy Molecular Biology Server) for computer simulated (*In silico*) digestion. ACE inhibitory activities of the peptides were measured by computer simulation.

Egg proteins were hydrolyzed at optimum conditions, *In vitro* ACE inhibitory activities of these hydrolysates were measured in our laboratory.

Most potent peptides were then identified in egg protein hydrolysates. Then we developed a multistep chromatographic process to purify most active peptides.

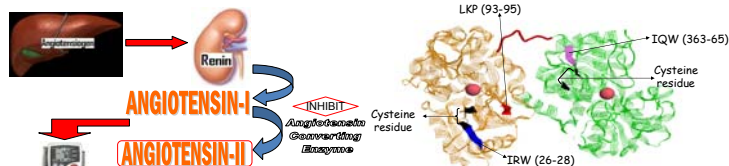


Figure 1: Renin- Angiotensin Cycle

Figure 2: ACE inhibitory peptides from Ovotransferrin

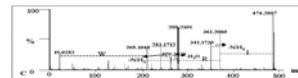
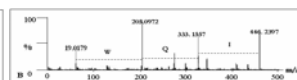
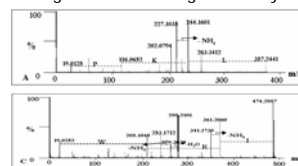


Figure 3: LC-MS/MS spectrum of the purified peptides. (A) LKP, (B) IQW, (C) IRW.

## OUR OBSERVATION

*In silico* proteolysis of major egg proteins generated over 20,000 of different kinds of peptides. A number of the new sequences with potent ACE inhibitory activity have been identified.

Ovotransferrin, an egg white protein hydrolysate with an  $IC_{50}$  value (concentration of peptide to inhibit the activity of enzyme by 50%) of  $9.14 \mu\text{g/ml}$  was achieved according to our established condition. This is the most potent protein hydrolysate that ever reported in literature.

Three most potent peptides IRW, IQW and LKP were identified in the hydrolysate. These three peptides were purified from crude protein hydrolysate by chromatographic separation.

The potent peptides were chemically synthesized and their ACE inhibitory activity was measured and compared with the purified peptides.

Peptides	Predicted $IC_{50}$ Value	$IC_{50}$ value synthetic peptide	$IC_{50}$ value purified peptide
IQW	$1.41 \mu\text{M}$	$1.56 \mu\text{M}$	$1.54 \mu\text{M}$
IRW	$0.59 \mu\text{M}$	$0.61 \mu\text{M}$	$0.64 \mu\text{M}$
LKP	$2.81 \mu\text{M}$	$2.03 \mu\text{M}$	$2.34 \mu\text{M}$

## WHAT DOES THIS MEAN

Cardiovascular disease especially hypertension is the leading cause of mortality and inability in Canada and USA. Bioactive peptides isolated from this study will significantly improve our knowledge between egg and human health which would facilitate the use of egg or egg products as functional food, to set up an alternative strategy for the prevention and treatment of hypertension.

## ACKNOWLEDGEMENT

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