BIOINFORMATION
Discovery at the interface of physical and biological sciences

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Volume 10(9)

Seed Pro-Nutra Care: A tool for characterization of seed storage proteins and database of bioactive peptides having potential health benefits

Anil Kumar*, Ajay Goyal, Anshita Goel & Dinesh Pandey

Department of Molecular Biology & Genetic Engineering College of Basic Sciences & Humanities, G.B. Pant University of Agriculture & Technology, Pantnagar-263 145 (India); Anil Kumar - Email: anilkumar.mbge@gmail.com; *Corresponding author

Received August 22, 2014; Accepted August 31, 2014; Published September 30, 2014

Abstract:
Seed storage proteins, the major food proteins, possess unique physicochemical characteristics which determine their nutritional importance and influence their utilization by humans. Here, we describe a database driven tool named Seed Pro-Nutra Care which comprises a systematic compendium of seed storage proteins and their bioactive peptides influencing several vital organ systems for maintenance of health. Seed Pro-Nutra Careis an integrated resource on seed storage protein. This resource help in the (I) Characterization of proteins whether they belong to seed storage protein group or not. (II) Identification the bioactive peptides with their sequences using peptide name (III) Determination of physico chemical properties of seed storage proteins. (IV) Epitope identification and mapping (V) Allergenicity prediction and characterization. Seed Pro-Nutra Care is a compilation of data on bioactive peptides present in seed storage proteins from our own collections and other published and unpublished sources. The database provides an information resource of a variety of seed related biological information and its use for nutritional and biomedical application.

Availability: http://www.gbpuat-cbsh.ac.in/departments/bi/database/seed_pro_nutra_care/

Keywords: Seed Storage Protein, Bioactive Peptide, Seed Pro-Nutra Care.

Background:
Seed storage proteins of cereal grain crops meet the major dietary protein requirement of over half of the world population **[1].** These seed storage proteins provide over 200 million tonnes of protein for the nutrition of humans and livestock. Seed storage proteins were among the earliest of all proteins to be characterized due to their abundance and economic importance **[2].** All seeds contain one or more groups of storage proteins which are present in high amounts and which serve to provide a store of amino acids for use during germination and seedling growth. Seed storage proteins are synthesized only in the seed (in cotyledon or in endosperm) and lack any other functional activity besides storage. Based on their solubility in different solvents, seed storage proteins are divided into four groups: albumins (water soluble), globulins (salt soluble), glutamines (soluble in diluted acid/base), and prolamins (alcohol soluble) **[3].** Albumins and globulins comprise the storage proteins of dicots (e.g. pulses), whereas prolamins and glutelins are major proteins in monocots (e.g. cereals). Albumins and globulins are preferentially synthesized in initial stages of grain development and other storage proteins are synthesized in later stages **[4].**

The seed storage proteins can be distinguished from other proteins by some of their unique characteristics. Storage proteins carry out the same function in various species, viz. they supply the developing embryo with nitrogen, sulfur, and carbon and their genes are regulated by similar mechanisms and regulatory elements. Some seed storage proteins are characterized by the presence of conserved motif like zein motif for prolamin, cupin motif for globulin and internal repeat sequence followed with hexapeptide repeat for albumin.

This integrated database aims at providing a compendium of browsable information for bioactive peptides, epitope mapping and physiochemical properties of seed storage proteins which will greatly facilitate researchers who wish to use this information to improve seed storage proteins in cereals or use them for nutritionally enhanced product. Among several databases focus on seed storage protein encoded in the plants, Seed Pro Nutra Care is the primary database which integrates information of bioactive peptides and physiochemical properties, allergenicity and immunogenicity of seed storage proteins. Seed Pro Nutra Care thus provides a comprehensive view of seed storage proteins and their bioactive peptides that will be a valuable resource for deciphering the nutritional and therapeutic values.

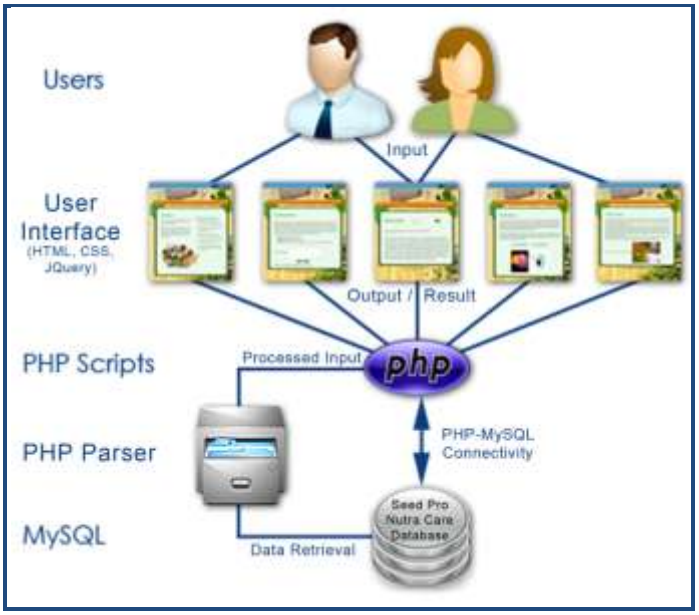

Figure 1: The Work flow of overall methodology

Methodology:

Construction of Seed Pro-Nutra Care

Seed Pro-Nutra Care was constructed using Hypertext Mark-up Language (HTML), Cascading Style Sheet (CSS), JQuery, AJAX, and Hypertext Preprocessor (PHP). Web server is implemented in Apache & MYSQL for PHP environment and database handling. PHP scripts and programs are written for database connectivity, accessing data, creating search, filtering, displaying simplified results and creating motif search tool.

Like our previously published databases Phyto Diab Care **[5]** and Tripath **[6],** Seed Pro Nutra Care database is available online at http: // www.gbpuat-cbsh.ac.in/departments /bi/database /seed_pro_nutra_care/ . The database also accessed using peptide name/ sequence for information on specific peptide. Further, a tool is developed for searching of seed specific motifs in the entered nucleotide sequence. On query, the tool returns the position of each motif along with highlighting with a specific color. Thus, a given query sequence can easily be analyzed for seed specificity by using this tool. The Work flow of overall methodology is shown in **Figure 1.**

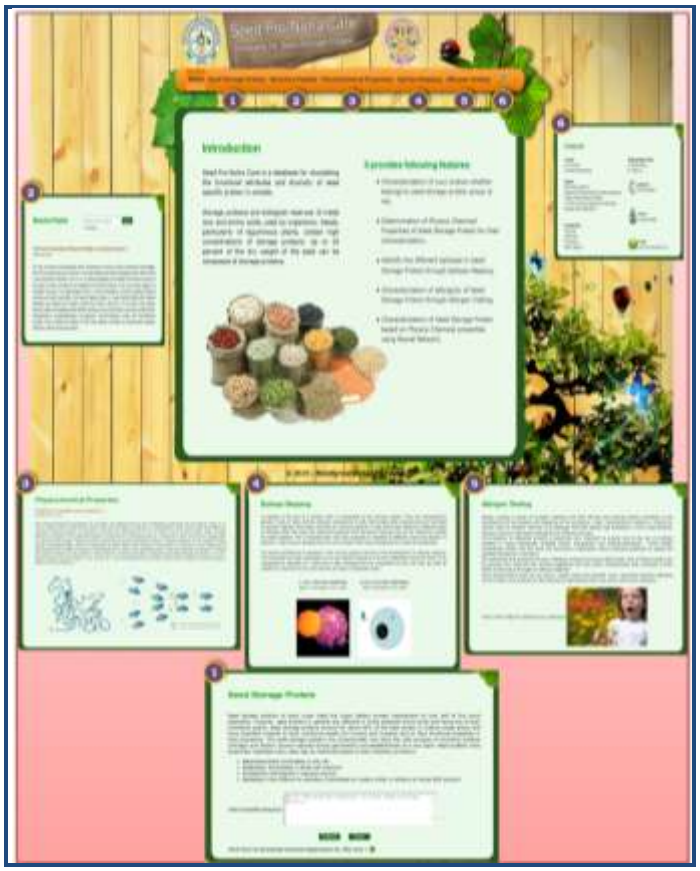

Figure 2: The composite snapshot shows the various sections of the Seed Pro Nutra-Care database. The sections are as follows - **(1)** Seed Storage Protein **(2)** Bioactive peptide **(3)** Physiochemical Properties **(4)** Epitope Mapping **(5)** Allergen Testing **(6)** Contact Us pages.

Database Description

Database is a collection of diverse information on bioactive peptide, physiochemical properties, epitope mapping and allergen testing including the information on the functional attributes and diversity of seed specific protein in cereals.

This database contains data on about 2400 bioactive peptides which were obtained from different sources from the web. Each bioactive peptide included in this database is represented by a separate entry containing protein sequence of peptide. These peptides exhibit different activities, such as antimicrobial, antioxidant, antithrombotic, antihypertensive, hypocholesterolemic, hypoglycemic, immunomodulatory, opioid, and antiproliferative activities. They can affect the condition of major body systems, and these are cardiovascular, digestive, endocrine, immune and nervous system. **Figure 2** is showing the composite snapshot of various sections of the Seed Pro Nutra-Care database.

Utility:
Seed Pro-Nutra Care database provides information on physico-chemical properties of seed storage proteins and their molecular characterization. With the help of this database users can characterize of their protein whether their protein sequence of interest belongs to seed storage protein group or not. Seed Pro-Nutra Care also allows us to identify the bioactive peptides in the seed storage proteins of interest. This database helps for identification of different epitopes through epitope mapping and characterization of allergicity through allergen testing in seed storage protein.

This type of database approach can make important contributions toward a more complete and holistic knowledge of seed storage proteins, their potential health benefits and subsequently use of information for making nutritionally important product and functional foods.

Future Development:
In the future, we intend to keep developing Seed Pro-Nutra Care database as a comprehensive information system for relevant seed storage proteins. This would be achieved by integrating literature mining, bio active peptide data and sequence-level information for cereals, legumes and other crops.

Acknowledgments:
Authors are grateful to Sub-DIC, Bioinformatics at G.B. Pant University of Agriculture and Technology, Pantnagar, India for providing computational facility. We also thank the Department of Biotechnology, Government of India, for providing financial support.

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Edited by P Kangueane
Citation: **Kumar *et al.*** Bioinformation 10(9): 592-594 (2014)