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Bioinformatics: The Fate Swap of Biological Sciences in Pakistan

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Abstract

Bioinformatics has now become a global trend, is equipped with all the tools crucial for high through put analysis of biological data. But it is not overlooked in a country like Pakistan in which it has routes in genetics, pharmaceutical industry, environmental and health sectors. The need of hour is to cover up the gap of Bioinformaticians to establish more tools to integrate and analyse the diverse biological data.

Introduction

Bioinformatics implements the algorithm, statistics and computer science to figure out the biological problems. It owns a huge information regarding the structural and functional characteristics of not only the genes but also of their products; the proteins, in the form of databases [1,2]. In Pakistan bioinformatics is under progress as Pakistan itself. The impact of bioinformatics tools is very crucial in disease diagnosis and determining tribal affinities among different ethnic groups in Pakistan [3,4]. Bioinformatics databases even deal with the allergens to combat the health issues [5].

It has strong impact on drug discovery and trial phase whether it is preclinical or clinical. However, pharmaceutical companies face difficulties during drug manufacturing which could be resolved with the aid of bioinformatics. This would eventually help us to deal with genomics, diagnosis and disease treatment in a precise way [6]. Bioinformatics tools need to be executed within Pakistan as the country is producer of varied crops, vegetables and fruits render the large genetic diversity which will be valuable in the high throughput research of biological data [7].

Bioinformatics tools applied to environmental sector is helpful in study of bioremediation. Also, EGTDC (Environmental Genomics Thematic Programme Data Centre) is working to provide easy access to researchers to interpret genomic data results throughout the world [8]. This article has intended to see everyone's sights on bioinformatics work in Pakistan especially in KPK. The bioinformatics tools are being in practice in KPK, Punjab and other provinces of Pakistan for the analysis and diagnosis of several diseases like albinism and glaucoma, for the implementation of best treatment approaches.

Mystery of Bioinformatics

Bioinformatics is a cocktail of computer, mathematic algorithm and statistics with roots in biological sciences

for solving the biological problems. High-throughput bioinformatics analysis employs through pipeline framework and efficiently carried out by means of different tools on command. The bioinformatics is teemed with its advantages over the conventional techniques. It is time efficient, less laborious and huge amount of data can be stored in a website that constitute a database and specific regional databases, There are variety of bioinformatics tools that employs web services also comprises rapid and authentic identification [1,2].

Attributes of Bioinformatics in Pakistan

Pakistan is a country that is at forefront of utilizing the latest tools of bioinformatics but still there are hasty advancements made, within last few years (Figure 1). Bioinformatics tools are employed in determining paternal lineage and personal identification of population of KPK. This is very influential in finding out the affinities within tribes residing in Pakistan.

Figure 1: Attributes of Bioinformatics in Pakistan.

Impact of Bioinformatics to combat diseases

Bioinformatics play vital role to determine the frequencies and clinical consequences of different diseases that ultimately results in earlier and faster diagnosis with better treatment strategies. The diseases that have undergone research in Pakistan include *OCA* (OculoCutaneous Albinism) predominantly in Punjab province, in silico analysis reveals the missense mutations in *CYP1B1* gene causing primary congenital glaucoma [3, 4]. Bioinformatics is very efficient in developing hierarchical strategies for rapid, feasible, and cost efficient genetic diagnostic assays for improved carrier detection and genetic counselling (Table 1).

Disease	Province	Research	Bioinformatics tools	Reference
OCA (oculocutaneous albinism)	Punjab	Identification and determination of OCA alleles in families	XHMM, CoNIFER	[3]
Tuberculosis	KPK	Mutational analysis of RRS gene in Mycobacterium tuberculosis	(NCBI) and offline softwares (MEGA 6 and BioEdit	[9,10]
Primary congenital glaucoma.	Punjab	Characterization of the five missense mutations in CYP1B1 gene	Phyre2 server (Protein Homology/AnalogY Recognition Engine), CPHmodel,Qmean server, PROCHECK,PrsA-web server	[4]
Mental retardation	N/A	Identification of TUSC3 involved in mental retardation	MEGA5, MuPro,PHDSNP, RAMPAGE,PROChECK	[11]

Hepatitis C	N/A	Testing the diagnostic and therapeutic capabilityofmi-RNAisdisease propagation	SPSS software version 16.0,Prism 6 software version 6.07	[9]
Solid tumors	N/A	Inhibition of Serine /threonine kinases involved in cell growth and proliferation by mTOR inhibitors	Auto Dock vina Discovery studio visualization	[12]
Prostate cancer	N/A	Sorting out SNPs involved in onset of cancer due to presence in coding region of STEAP2 gene	PolyPhen 2, SIFT, PHDSNP,PROVEAN, MutPred, MuPro,I-mutant, I-TASSER, ERRAT,Galaxy refine	[13]
Scarlet fever	N/A	Structural and functional characterization Domain involved in drug transportation	BLAST, ProtParam, I-TASSER, TMHMM v2.0	[14]

Table 1: Research work conducting in Pakistan to combat diseases.

Bioinformatics: A New Window to Health Care Informatics

Pakistan has its distinctive resources in field of genetics, pharmaceutical industry, and environmental protection and in improving human health [10]. A wide range of health issues have been encountered due to the allergens. It demands the complete information which is owed to the Bioinformatic databases. These databases have compiled the data regarding the structure of allergens especially their epitopes to analyse the cross reactivity of these allergens with the CDRs (Figure 2). The most striking feature of bioinformatics is that it is independent of wet lab techniques. One can overcome all health issues by using web services [5]. In Lahore, a city of Pakistan, allergic responses in asthma patients are analysed at genetic level by the HaploReg bioinformatic tool [9].

Bioinformatics: A new Approach for Food

In Pakistan, about 21% of total GDP is based on agriculture but food inflation is a major problem that poses serious problems on its economy. Food stuff acquired by agriculture is largely equipped with mycotoxins. Therefore demand of time is to control mycotoxins and prevent food from spoilage [15]. Next generation sequencing is pace to develop new data streams to trace and identify pathogens, establish processes that reduce health risks associated with food and ensure authentic, manifest and auditable practices concealed with foodstuff associated risks [16].

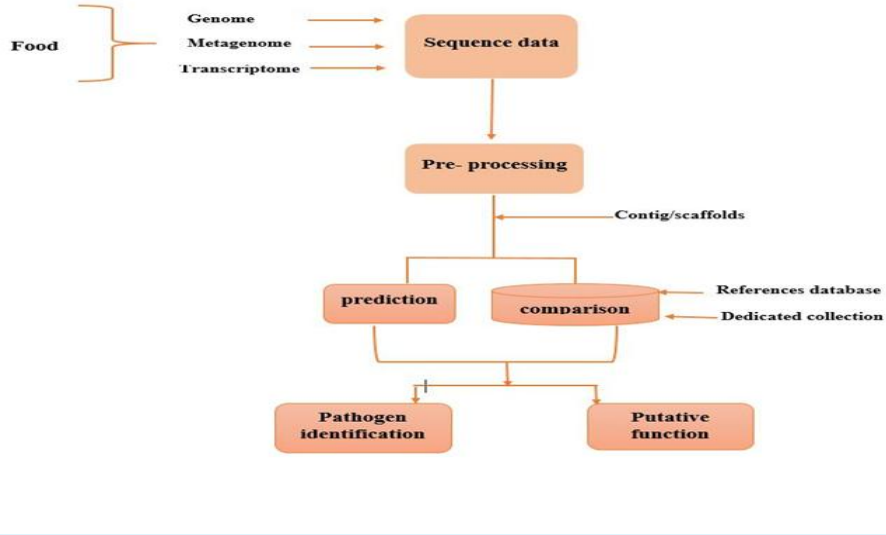

Figure 2: A schematic approach to identify pathogen through bioinformatics.

Bioinformatics: In medicinal chemistry

Drug repositioning and target identification are major challenges to bioinformatics. Drug repositioning is required to avoid any risk associated with use of previously approved drug for some other medical conditions i.e. increased sensitivity and resistance as in the case of human cancer cell lines. It is most important to estimate whatever a target is able to survive with a particular drug dosage or not [6]. Identification of target candidates performed with the aid of different tools such as CADD (Computer Aided Drug Designing), ROCS (Rapid Overly of Chemical Structure) and QSAR (Quantitative Structure Activity Relationship) that predicts 3D structure of targets to assess binding, pharmacophore (ligand) based binding of drug candidates and screening of drugs to get best therapeutic effects respectively [17]. The drugs as Dorzolamide, Capoten, Aluviran and Imatinib have been designed using the bioinformatics tools in these cases by use of SGDD technique [16,17,18].

Bioinformatics: A toolkit for environmental analysis

Regarding environmental role, bioinformatics presents many gripping possibilities for the process of bioremediation which can be studied by associating biodegradation related information with relevant proteomics and genomic data [18]. EGTDC (Environmental Genomics Thematic Programme Data Centre) works with an aim to expand and implement bioinformatics tools. It works for combined furnishing of computers, software, bioinformatics advisor and appropriate data standards with a goal to assist researchers an easy access, store and make effective interpretation of their genomic data. ETDGC also has devised a public catalogue that stores information for about 28 environmental genomic grants and a sum of 314 data holdings of varied types which include SNPs, Microsatellites, gene library, genetic maps, publications etc. [8].

Intense need of Computational Biology in Pakistan

Although, Bioinformatics is a rapidly growing field however, in Pakistan, there is dearth of Bioinformaticians to face the challenges to have deep insight towards the development of new tools for effective analysis of biological data [7]. Bioinformatics need to scrutinize in Pakistan as the country is blessed with exotic genetic resources. Because of its geographical location, climate changes and residence of different ethnic groups within a population of about 200 million, Pakistan offers a large genetic diversity to study genetic abnormalities The current goal is to highlight the role and importance of various bioinformatic approaches in different life sectors of Pakistan and to produce trained Bioinformaticians to fill the academic gap to meet worldwide challenges in this sector [10].

Conclusion

Bioinformatics assist the scientists to handle large no. of genomics and proteomics data by providing the basic knowledge of connection between genotype and phenotype of a particular disease.In future, bioinformatics relies on “integration” such as to predict genetic mutation becoming the cause of disease and large-scale comparative genomics. Hurdles in the way of bioinformatics so far include limited storage space of disks and expanded bands. Bioinformatics mimics biological observation into language that computer can understand. All these hurdles offer scientists with an opportunity to make amendments in the field of bioinformatics.

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