

# Establishing A Remedy Of Dyslexia From Indian Traditional Herbs By *in-silico* Methods

Tabassum Siddiqua<sup>1</sup>, Preenon Bagchi<sup>2,3</sup>, Arpitha BM<sup>1</sup> and Ajit Kar<sup>3</sup>

<sup>1</sup>Department of Biotechnology, Dayananda Sagar College of Engineering, Bangalore, India. <sup>2</sup> Department of Biotechnology, Padmashree Institute of Management & Sciences, Bangalore, India. <sup>3</sup>Sarvasumana Association, Bangalore, India.

*Abstract:* Dyslexia is a major childhood disorder. It causes learning disability because of which several behavior flaw is noticed like stammering, faulty writing, lack of attention and seen these children more energetic than normal children of same age. Recent studies suggest association of dyslexia with multiple gene mutations. In this work, we are identifying the genes responsible for dyslexia, establishing their 3d structure by using the structural coordinates of homologous templates. Several medicinal herbs from Ayurvedic, Siddha and Unani background are found to have a cure for neurological disorders. In this work we are targeting the compounds from these herbs against the gene receptors as potential ligands for the disorder.

*Keywords:* dyslexia, medicinal herbs, homology modelling, virtual screening

#### I. INTRODUCTION

Dyslexia is a language-based learning disability. Dyslexia refers to an association of symptoms, which result in people having difficulties with specific language skills, particularly reading. Dyslexia, or developmental reading disorder, is characterized by difficulty with learning to read fluently and with accurate comprehension despite normal or aboveaverage intelligence. Students with dyslexia usually experience difficulties with other language skills such as spelling, writing, and pronouncing words. Dyslexia affects individuals throughout their lives, however, its impact can change at different stages in a person's life. It is referred to as a learning disability because dyslexia can make it very difficult for a student to succeed academically in the typical instructional environment, and in its more severe forms, will qualify a student for special education, special accommodations, or extra support services [1, 2]. Genes associated to dyslexia referred in this work are DCDC2, KIAA0319, DYX1C1, CMIP [3].

#### DCDC2: DOUBLECORTIN DOMAIN-CONTAINING 2

This gene encodes a doublecortin domain-containing family member. The doublecortin domain has been demonstrated to bind tubulin and enhance microtubule polymerization. This family member is thought to function in neuronal migration where it may affect the signaling of primary cilia. Mutations in this gene have been associated with reading disability (RD) type 2, also referred to as developmental dyslexia. Alternatively spliced transcript variants encoding the same protein have been found for this gene. Mutations in this gene have been associated with reading disability (Rd) also referred to as developmental dyslexia.

Changes in the DCDC2 gene are frequently found among dyslexics. Altered alleles often occur among children with riding and writing difficulties. The gene appears to have a strong linkage with the processing of speech information when writing [4, 5].

#### KIAA0319:

KIAA0319 is a protein which in humans is encoded by the KIAA0319 gene and its variants of the KIAA0319 gene have been associated with developmental dyslexia. Reading disability, also called dyslexia, is a major social, educational, and mental health problem associated with it. In spite of average intelligence and adequate educational opportunities, 5 to 10% of school children have been detected having substantial reading deficits. Twin have shown a substantial genetic component to this disorder, with heritable variation estimated at 50 to 70%. An NIDCD-supported investigator has identified a mutation in a gene on chromosome 6, called the KIAA0319 gene, that appears to play a key role in Specific Language Impairment. The KIAA0319 protein is expressed on the cell membrane

#### © IJPMN, Volume 3, Issue 2, August-2016



and may be involved in neuronal migration and furthermore, KIAA0319 follows a clathrin-mediated endocytic pathway [6, 7, 8].

#### DYX1C1: DYSLEXIA SUSCEPTIBILITY 1 CANDIDATE 1

This gene encodes a tetratricopeptide repeat domaincontaining protein. The encoded protein interacts with estrogen receptors and the heat shock proteins, Hsp70 and Hsp90. An homologous protein in rat has been shown to function in neuronal migration in the developing neocortex. A chromosomal translocation involving this gene is associated with a susceptibility to developmental dyslexia. Mutations in this gene are associated with deficits in reading and spelling. Alternative splicing results in multiple transcript variants [9, 10].

#### **CMIP: C-MAF INDUCING PROTEIN**

This gene encodes a c-Maf inducing protein that plays a role in T-cell signaling pathway. Alternatively spliced transcript variants encoding different is forms have been described for this gene. CMIP is a protein coding gene diseases associated with CMIP include speech and communication disorder specific language impairment [11].

#### II METHODOLOGY

Dyslexia receptor amino acid sequences were downloaded from NCBI (Table 1). Their 3d structure was modelled using swiss model.

Table 1: Dyslexia receptors with their NCBI

Accession number

Gene name	Accession number
DCDC2	AAH50704.1
KIAA0319	BAA20777.3
DYX1C1	NP_570722.2
CMIP	AAH38113.1

Herbs useful in treating CNS disorders are used in this work [12, 13, 14, 15, 16]. The active compounds of the herbs used in this work are downloaded from PUBCHEM (Table 2)

Table 2: Herbs with their compounds used in this work.

Herb name	Scientific	Compounds
	name	
Schizandra	Schisandra	Schizandrin
	chinensis	Deonyschizandrin
		Gomisine
Kava kava	Piper	Kavain

	methysticum	Caffeic Acid
		Dihydrokavain
		Methysticin
		Dihydromethysticin
		Yangonin
		Desmethoxyangonin
		Allantoin
		Rosmaric Acid
		Methyl Oleanolate
		Stignasterol
		Isoleucine
		Phynyalarine
Piperaceae	Piper caninum	Bornyll Caffeate
	Rheum	Cinnanic Acid
	officinale	
	Forsythia	Pinoresinol
	suspensa	
	Podophyllum	Pudophyllotonin
	peltatum	
	Nardostachys	Valeranone

The active compounds of the herbs are docked with the dyslexia receptors DCDC2, KIAA0319, DYX1C1 and CMIP in this work.

jatamansi

#### III RESULTS & DISCUSSION

Amino acid sequence of the gene responsible for Dyslexia was retrieved from Genbank/Uniprot database and their accession number was noted.

Structure modeling was done using using Swiss Model. Unknown and reference ligand were identified and virtual screening and docking studies was performed on the ligands with the receptor proteins.

Table 3: Docking analysis of the dyslexia receptors with the active compounds of the CNS herbs

COMPOUN	DOC	INTER	NO. OF	DOC
DS docking	KING	ACTIN	INTER	KIN
with DCDC2	SCO	G	ACTIO	G
receptor	RE	AMIN	NS	(YES
	KCA	0		/NO)
	L/MO	ACIDS		
	L			
BRONYL	2612	LEV	1	YES
CAFFEATE	KCA	190		
	L/MO			
	L			
CINNAMIC	2208	THR	1	YES
ACID	KCA	189		

## © IJPMN, Volume 3, Issue 2, August-2016



			1	1
	L/MO L			
PINORESIN	3784	ARG	1	YES
OL	KCA	180	_	
	L/MO			
	L			
PODOPHYL	3814	GLN	1	YES
LOTOXIN	KCA	136	1	110
Loronny	L/MO	150		
	L			
VALERANO	2208	THR	1	YES
NE	KCA	189	_	
	L/MO			
	L			
ALLANTOI	1892	PHE	1	YES
N	KCA	206	-	
	L/MO			
	L			
METHYSTI	2552	GLU	1	YES
CIN	KCA	202		
	L/MO			
	L			
DESMETHO	3100	GLY	1	YES
XYANGONI	KCA	204	1	
Ν	L/MO	PHE		
	L	206		
DIHYDROK	2538	ARG	1	YES
AVAIN	KCA	180	1	
	L/MO	THR		
	L	178		
ISOLUCINE	2032	PHE	1	YES
	KCA	206		
	L/MO			
	L			
KAVAIN	2470	THR	1	YES
	KCA	178		
	L/MO			
	L			
GOMISIN	2894	TYR	1	YES
	KCA	188	1	
	L/MO	PHE		
	L	215		
ROSMARIN	3790	THR	1	YES
IC ACID	KCA	178		
	L/MO			
	L			
DIHYDROM	3354	ARG	1	YES
ETHYSTICI	KCA	190		
Ν	L/MO			
	L			

PINORESIN	3784	ARG	1	YES
OL	KCA	180		
	L/MO			
	L			
STIGMAST	4590	ARG	1	YES
EROL	KCA	180		
	L/MO			
	L			
METHYLOL	NO			
EANOLATE	DOC			
	KING			
YANGONIN	NO			
	DOC			
	KING			
PHENYLAL	NO			
ARINE	DOC			
	KING			
COMPOUN	DOC	INTER	NO. OF	DOC
DS docking	KING	ACTIN	INTER	KIN
with KIAA	SCO	G	ACTIO	G
receptor	RE	AMIN	NS	(YES
receptor	KCA	0	145	(1E5 /NO)
	L/MO	ACIDS		/110)
	L/MO L	ACIDS		
	L			
GOMISIN	3540	LEV	1	YES
GOMIDIN				
			-	125
	KCA	684		120
	KCA L/MO			
	KCA L/MO L	684	1	
METHYSTI	KCA L/MO L 3222	684 ASN	1	YES
	KCA L/MO L 3222 KCA	684	1	
METHYSTI	KCA L/MO L 3222 KCA L/MO	684 ASN	1	
METHYSTI CIN	KCA L/MO L 3222 KCA L/MO L	684 ASN 715		YES
METHYSTI CIN ROSMARIN	KCA L/MO L 3222 KCA L/MO L 4938	684 ASN 715 ASN	1	
METHYSTI CIN	KCA L/MO L 3222 KCA L/MO L 4938 KCA	684 ASN 715		YES
METHYSTI CIN ROSMARIN	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO	684 ASN 715 ASN		YES
METHYSTI CIN ROSMARIN IC ACID	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L	684 ASN 715 ASN 715	1	YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910	684 ASN 715 ASN 715 SER		YES
METHYSTI CIN ROSMARIN IC ACID	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA	684 ASN 715 ASN 715	1	YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO	684 ASN 715 ASN 715 SER	1	YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L	684 ASN 715 ASN 715 SER	1	YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID PODOPHYL	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L NO	684 ASN 715 ASN 715 SER	1	YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L NO DOC	684 ASN 715 ASN 715 SER	1	YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID PODOPHYL LOTOXIN	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L NO DOC KING	684 ASN 715 ASN 715 SER 648	1	YES YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID PODOPHYL LOTOXIN ALLANTOI	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L NO DOC KING 2772	684 ASN 715 ASN 715 SER 648 ASN	1	YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID PODOPHYL LOTOXIN	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L NO DOC KING 2772 KCA	684 ASN 715 ASN 715 SER 648	1	YES YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID PODOPHYL LOTOXIN ALLANTOI	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L NO DOC KING 2772 KCA L/MO	684 ASN 715 ASN 715 SER 648 ASN	1	YES YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID PODOPHYL LOTOXIN ALLANTOI N	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L NO DOC KING 2772 KCA L/MO L	684 ASN 715 ASN 715 SER 648 ASN 780	1	YES YES YES
METHYSTI CIN ROSMARIN IC ACID CINNAMIC ACID PODOPHYL LOTOXIN ALLANTOI	KCA L/MO L 3222 KCA L/MO L 4938 KCA L/MO L 2910 KCA L/MO L NO DOC KING 2772 KCA L/MO	684 ASN 715 ASN 715 SER 648 ASN	1	YES YES YES

# © IJPMN, Volume 3, Issue 2, August-2016



L/MO	SLR		
L	795		
DESMETHO 3752	ASN	1	YES
XYANGONI KCA	715		
N L/MO			
L			
BORNYLCA NO			
FFEATE DOC			
KING			
DIHYDROM 4356	GLN	1	YES
ETHYSTICI KCA	685	2	
N L/MO	ASN		
	715	1	VEC
ISOLEUCIN 2794	ASN	1	YES
E KCA L/MO	780 THR	1	
PINORESIN NO	779		
OL DOC			
KING			
STIGMAST NO			
EROL DOC			
KING			
METHYLOL NO			
EANOLATE DOC			
KING			
YANGONIN NO			
DOC			
KING			
PHENYLAL NO			
ARINE DOC			
KING			
COMPOUN DOC	INTER	NO. OF	DOC
DS docking KING	ACTIN	INTER	KIN
with CIMP SCO	G	ACTIO	G
receptor <b>RE</b>	AMIN	NS	(YES
KCA			/NO)
L/MO	ACIDS		
L			
GOMISIN 3526	HIS 556	1	YES
KCA	1115 550	1	115
L/MO			
METHYSTI NO			
CIN DOC			
KING			
ROSMARIN NO			
ROSMARINNOIC ACIDDOC			

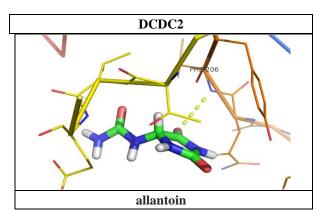
ACID KINGDOC KINGARG AIIYESPODOPHYL LOTOXIN4720 KCA L/MOARG S011YESALLANTOI NNO DOC KINGIYESALLANTOI NNO DOC KINGIYESSCHIZAND RIN3680 KCA L/MO LGLU1YESSCHIZAND RIN3544 KCA L/MO LGLU1YESBORNYLCA N FFEATE DOC KINGIYESYESDIHYDROM FFEATE DOC KINGIYESYESDIHYDROM FFINORESIN C4174 L/MO LIYESPINORESIN CATA L/MO LIYESSTIGMAST EROL510 L/MO LIYESSTIGMAST FRANCAS101 L/MO LIYESMETHYLOL DOC KINGARG L/MO LIYESSTIGMAST FRONLATE ANOLATES100 L/MO LIYESSTIGMAST FRONLATE ANDAS101 LIYESYANGONIN ANGGLU L/MO LIYESYANGONIN ANDAGLU L/MO LIYESYANGONIN ANDAGLU L/MO LIYESYANGONIN ANDAGLU L/MO LIYESYANGONIN ANDAGLU L/MO LIYESYANGONIN ANDAGLU L/MO LIYESYANGONIN ANDAGLU L/MO LIYESYANGONIN CGLU L/MO LI <th></th> <th>1</th> <th>1</th> <th>1</th> <th></th>		1	1	1	
KINGKINGIYESPODOPHYL LOTOXIN4720ARG1YESKCA501IYESLOTOXINKCA501IIALLANTOINOIIYESALLANTOINOIYESINODOCIIYESSCHIZAND3680GLU1YESRINKCA527IYESL/MOIYESYESXYANGONIKCA527IYESNL/MOIYESBORNYLCANOIYESFFEATEDOCIYESDIHYDROM4174ALA1YESFISOLEUCINNOIYESISOLEUCINNOIYESOLL/MOIYESSTIGMAST5100ARG1YESSTIGMAST5100ARG1YESFROLKCA521IIMETHYLOLNOIYESGNGSUGIYESSTIGMAST5100ARG1YESYANGONIN4040GLU1YESYANGONINKCA527IIYANGONINKCA514IYESFUNCESINSUGASUGIYESGUKCASUGIYESFUNCESINSUGIYESFUNCESINSUGIYESG	CINNAMIC	NO			
PODOPHYL LOTOXIN4720 KCA KCA L/MO LARG S01 L/MO L1YESALLANTOI NNO DOC KINGIIYESALLANTOI NNO DOC KINGIYESSCHIZAND RIN3680 KCA L/MO LGLU1YESSCHIZAND N3754 L/MO LGLU1YESDESMETHO XYANGONI N3754 L/MO LGLU1YESBORNYLCA NNO LIYESDIHYDROM FFEATE N4174 L/MO L1YESDIHYDROM FE N4174 L/MO L1YESDIHYDROM F4174 L/MO L1YESSTIGUEUCIN CNO LIYESSTIGMAST EROL L5100 LARG S01 L1YESSTIGMAST EROL LS100 KCA L/MO LARG S01 L1YESYANGONIN HOU L4040 LGLU1YESYANGONIN AUMO LGLU1YESYANGONIN AUMO LGLU1YESYANGONIN AUMOGLU1YESYANGONIN AUMOGLU1YESYANGONIN LM000GLU1YESYANGONIN AUNNEGOCINTER AUNNEAUNOICOMPOUN DOCINTER KINGNO. OFOCCCOMPOUN AUNNEGOCINTER AUNNEGOCNOIIYES	ACID	DOC			
LOTOXINKCA L/MO L501IIALLANTOI NNO DOC KINGIIIALLANTOI NNO DOC KINGIIYESSCHIZAND RIN3680GLU L/MO L1YESSCHIZAND N3754 L/MO LGLU S271YESDESMETHO XYANGONI L3754 KCA L/MO LGLU S271YESBORNYLCA FFEATE DOC KINGNO LIYESBORNYLCA FFEATE DOC LNO LIYESDIHYDROM E4174 L/MO LALA S261YESDIHYDROM CLIYESSOLEUCIN CNO LIYESPINORESIN CLA740 LLEU I1YESSTIGMAST EROL5100 LARG S01 L1YESSTIGMAST ENOL L/MO L5101 LARG S111YESYANGONIN A040 LGLU1YESYANGONIN A040 LGLU1YESPHENYLAL ANINE L3310 LLEU S401YESCOMPOUN DS dockingGOC KINGINTERMOC KINGI		KING			
L/MO LI/MO LI/MO LI/MO HALLANTOI NNO DOC KINGIISCHIZAND RIN3680 KCAGLU 5271YESSCHIZAND RIN3680 KCAGLU 5271YESDESMETHO XYANGONI3754 KCAGLU 5271YESDESMETHO XYANGONI3754 KCAGLU 5271YESBORNYLCA N FFEATENO LIYESDIHYDROM ETHYSTICI N L4174 LALA 5261YESISOLEUCIN C LNO LIYESPINORESIN OL L4174 LALA S261YESDIHYDROM E DOC L1YESSTIGMAST EROL L510 L1YESSTIGMAST EANOLATE DOC LARG S01 L1YESMETHYLOL PHENYLAL ANINEAU0 LIYESPHENYLAL ANINE310 KCA L/MO L1YESPHENYLAL ANINEACTIN KINGNO. OF INTEROC	PODOPHYL	4720	ARG	1	YES
L/MO LI/MO LI/MO LI/MO HALLANTOI NNO DOC KINGIISCHIZAND RIN3680 KCAGLU 5271YESSCHIZAND RIN3680 KCAGLU 5271YESDESMETHO XYANGONI3754 KCAGLU 5271YESDESMETHO XYANGONI3754 KCAGLU 5271YESBORNYLCA N FFEATENO LIYESDIHYDROM ETHYSTICI N L4174 LALA 5261YESISOLEUCIN C LNO LIYESPINORESIN OL L4174 LALA S261YESDIHYDROM E DOC L1YESSTIGMAST EROL L510 L1YESSTIGMAST EANOLATE DOC LARG S01 L1YESMETHYLOL PHENYLAL ANINEAU0 LIYESPHENYLAL ANINE310 KCA L/MO L1YESPHENYLAL ANINEACTIN KINGNO. OF INTEROC	LOTOXIN	KCA	501		
LImageImageImageImageALLANTOI NNO DOC KINGImageImageImageSCHIZAND RIN3680 L/MO LGLU T1YESSCHIZAND RINKCA L/MO L527ImageImageDESMETHO XYANGONI NXCA L/MO L1YESBORNYLCA FFEATE DOC KINGNImageImageBORNYLCA FFEATE DOC LNImageImageDIHYDROM E DOC L/MO4174 L/MO LALA T1YESDIHYDROM E DOC L/MOImageImageImageDIHYDROM C4174 L/MO LALA T1YESSOLEUCIN C N CNO LImageImagePINORESIN COL LAT40 LLEU TImageImageSTIGMAST EROL LS100 L/MO LARG T1YESSTIGMAST EANOLATE DOC LNO TImageImageYANGONIN Advid LGLU1YESYANGONIN ANINEGLU L/MO1YESPHENYLAL ANINEAS10 L/MOImageImagePHENYLAL ANINEACTINNO. OF INTEROC IMTERImage					
ALLANTOI NNO DOC KINGImage with the second seco					
NDOC KINGImage of the sector of th					
KINGImageImageImageSCHIZAND3680GLU1YESRINKCA527ImageImageL/MOImageImageImageImageDESMETHO3754GLU1YESXYANGONIKCA527ImageImageNL/MOImageImageImageSORNYLCANOImageImageImageFFEATEDOCImageImageImageBORNYLCANOImageImageImageFFEATEDOCImageImageImageDIHYDROM4174ALA1YESDIHYDROM4174ALA1YESDIHYDROM4174ALA1YESDIHYDROMKCA526ImageImageISOLEUCINNOImageImageImagePINORESINAT40LEU1YESOLKCA514ImageImageOLImageImageImageImageSTIGMAST5100ARG1mageImageIMETHYLOLNOImageImageImageFANOLATEDOCImageImageImageYANGONIN4040GLU1mageYESIMETHYLOLImageImageImageIMETHYLOLImageImageImagePHENYLAL3310LEU1mageYESIMANINEImageImageImageIMANIN					
SCHIZAND RIN3680 KCA L/MO LGLU 527 I1YES YES IDESMETHO XYANGONI N3754 L/MO LGLU 527 I1YES YES IDESMETHO XYANGONI N3754 L/MO LGLU I1YES YES IBORNYLCA FFEATE DOC KINGNO LIIDIHYDROM ETHYSTICI N4174 L/MO LALA I1YES YESDIHYDROM ETHYSTICI SOLEUCIN CNO LIYESISOLEUCIN DOC ENO LIYESPINORESIN CL4740 L/MO L11YESSTIGMAST EROL L/MO L5100 L/MO LARG I1YESSTIGMAST EROL L/MO L501 L/MO IYESIMETHYLOL EANOLATE DOC LNO EIYESYANGONIN AGA AGAGLU I1YESPHENYLAL ANINE L/MO L3310 LEU1YESFOMPOUN DOC L/MOIYESIPHENYLAL ANINE KCA540 L/MO L/MO1YESCOMPOUN DOC L/MOIYESICOMPOUN DOCMOC LIYES	IN				
RINKCA L/MO L527 HIIDESMETHO XYANGONI3754 KCA L/MO LGLU 5271YESNL/MO LIIBORNYLCA FFEATENO LIYESBORNYLCA FFEATENOC KINGIYESDIHYDROM T4174 L/MO L/MOALA1YESDIHYDROM TKCA L/MO526IISOLEUCIN CNO LIIYESSOLEUCIN CNO LIYESIPINORESIN CLAT40 L/MO L1YESSTIGMAST EROL5100 L/MO L/MOARG I1YESSTIGMAST EROL5100 L/MO L/MOIYESMETHYLOL EANOLATE DOC L/MOIYESIMETHYLOL EANOLATE ANINENO KCA S27IYESPHENYLAL ANINE3310 LEU1YESPHENYLAL ANINEGOC L/MO LIYESFOOPOUN DOCNO LIYESPHENYLAL ANINESCA L/MO1YESCOMPOUN DOCMOC L/MOIYESCOMPOUN DOCMOC LNO LIYESCOMPOUN DOCMOC LMO LIYESCOMPOUN DOCMOC LMO LIYESCOMPOUN DOCMOC LMO LIYESCOMPOUN DOCMOC LMO L <td></td> <td></td> <td>GL LL</td> <td></td> <td>TIPO</td>			GL LL		TIPO
L/MOLIYESDESMETHO3754GLU1YESXYANGONIKCA527IINL/MOIIIDORNYLCANOIIIFFEATEDOCIIIBORNYLCANOIIIFFEATEDOCIIIDIHYDROM4174ALA1YESETHYSTICIKCA526IIDOCL/MOIIIEDOCIIYESOLL/MOIYESIPINORESINNOIYESOLKCA514IYESOLLIYESSTIGMAST5100ARG1YESEROLKCA501IIL/MOIIYESMETHYLOLNOIIYESMETHYLOLNOIIYESMETHYLOLNOIIYESFANOLATEDOCIIYESYANGONIN4040GLU1YESYANGONINKCA527IIPHENYLAL3310LEU1YESANINEKCA540IIPHENYLALA310LEU1YESANINEKCA540IIL/MOIIIIANINEKCAS40 <t< td=""><td></td><td></td><td></td><td>1</td><td>YES</td></t<>				1	YES
LImage: constraint of the sector	RIN		527		
DESMETHO XYANGONI N3754 KCA S27GLU 11YESXYANGONI NKCA L/MO527BORNYLCA FFEATENO DOCBORNYLCA FFEATENO LDIHYDROM ETHYSTICI N4174 L/MOALA S261YESDIHYDROM ETHYSTICI NL/MO LISOLEUCIN ENO DOCISOLEUCIN CNO LPINORESIN OL4740LEU L1YESOLKCA L/MO LSTIGMAST EROL5100 L/MO LARG S011YESMETHYLOL EANOLATE DOC L/MO LNO CYANGONIN Advand L4040 CGLU1YESYANGONIN ANINE4040 L/MO L1YESPHENYLAL ANINE3310 LEU L/MO L1YESCOMPOUN DS dockingDOC KINGINTER KCANO. OF DOCDOC		L/MO			
XYANGONI NKCA527Internal Internal L/MOInternal LBORNYLCA FFEATENOInternal LOCInternal LInternal LBORNYLCA FFEATENOInternal LInternal LInternal LDIHYDROM ETHYSTICI N4174ALA1YESDIHYDROM ETHYSTICI NL/MOInternal LInternal LInternal LInternal LISOLEUCIN ENOInternal LInternal LInternal LYESPINORESIN OL4740LEU1YESPINORESIN OL4740LEU1YESSTIGMAST EROL5100ARG1YESSTIGMAST EROL5100ARG1YESMETHYLOL EANOLATENOInternal L/MOInternal InternalInternal Internal Internal InternalInternal Internal Internal Internal Internal Internal Internal Internal Internal InternalInternal Internal Internal Internal InternalInternal Internal Internal Internal Internal Internal Internal InternalInternal Internal Internal Internal InternalInternal Internal Internal Internal InternalInternal Internal I		L			
NL/MOIIIBORNYLCANOIIIBORNYLCANOIIIFFEATEDOCIIIDIHYDROM4174ALA1YESETHYSTICIKCA526IINL/MOIIIISOLEUCINNOIIYESOLDOCIIYESOLKINGIYESOLKCA514IYESOLLIYESOLLIYESSTIGMAST5100ARG1YESEROLL/MOIIYESMETHYLOLNOIIYESMETHYLOLNOIIYESMETHYLOLNOIYESIMETHYLOLNOIIYESPHENYLALA310GLU1YESPHENYLAL3310LEUIYESANINEKCA540IYESCOMPOUNDOCIIYESCOMPOUNDOCINTERNO. OFDOCDSOCKingKINGIYES	DESMETHO	3754	GLU	1	YES
NL/MOIIIBORNYLCANOIIIBORNYLCANOIIIFFEATEDOCIIIDIHYDROM4174ALA1YESETHYSTICIKCA526IINL/MOIIIISOLEUCINNOIIYESOLDOCIIYESOLKINGIYESOLKCA514IYESOLLIYESOLLIYESSTIGMAST5100ARG1YESEROLL/MOIIYESMETHYLOLNOIIYESMETHYLOLNOIIYESMETHYLOLNOIYESIMETHYLOLNOIIYESPHENYLALA310GLU1YESPHENYLAL3310LEUIYESANINEKCA540IYESCOMPOUNDOCIIYESCOMPOUNDOCINTERNO. OFDOCDSOCKingKINGIYES	XYANGONI	KCA	527		
LImage: lineImage: lineImage: lineBORNYLCANOImage: lineImage: lineFFEATEDOCKINGImage: lineDIHYDROM4174ALA1YESETHYSTICIKCA526Image: lineImage: lineNL/MOImage: lineImage: lineImage: lineISOLEUCINNOImage: lineImage: lineImage: lineBONRESINNOImage: lineImage: lineImage: linePINORESIN4740LEU1YESOLKCA514Image: lineImage: lineOLLImage: lineImage: lineImage: lineSTIGMAST5100ARG1YESEROLLImage: lineImage: lineImage: lineMETHYLOLNOImage: lineImage: lineImage: lineMETHYLOLImage: lineImage: lineImage: lineImage: lineMETHYLOLImage: lineImage: lineImage: lineImage: lineMETHYLOLImage: lineImage: lineImage: lineImage: lineMETHYLOLImage: lineImage: lineImage: lineImage: lineImage: lineImage: line<					
BORNYLCA FFEATENO DOC KINGIIFFEATEDOC KINGIYESDIHYDROM4174ALA1YESETHYSTICIKCA526IINL/MOIIIISOLEUCINNO EDOCIIPINORESIN4740LEU1YESOLKCA514IIOLLIYESOLKCA514IYESSTIGMAST5100ARG1YESEROLKCA501IIL/MOIIYESEROLNOIIYESYANGONIN4040GLU1YESYANGONIN4040GLU1YESPHENYLAL3310LEU1YESANINEKCA540IIPHENYLALAS10ILEU1YESCOMPOUNDOCINTERNO. OFDOCDSdockingKINGACTININTERKINGIINTERKINGI	1,				
FFEATEDOCIIINIHYDROM4174ALA1YESDIHYDROM4174ALA1YESETHYSTICIKCA526IINL/MOIIIISOLEUCINNOIIIEDOCIIYESOLKINGIIYESOLKINGIYESOLKCA514IYESOLLIYESSTIGMAST5100ARG1YESEROLKCA501IIL/MOIIYESEROLDOCIIYESMETHYLOLNOIIYESYANGONIN4040GLU1YESYANGONIN4040GLU1YESPHENYLAL3310LEU1YESANINEKCA540IIL/MOIIYESOLIIYESANINEKCA540IICOMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN	BORNVICA				
KINGIIDIHYDROM4174ALA1YESETHYSTICIKCA526IINL/MOIIIISOLEUCINNOIIIEDOCIIIPINORESIN4740LEU1YESOLKCA514IIDOCIIYESOLKCA514IIEROL5100ARG1YESEROLLIIYESMETHYLOLDOCIIYESEANOLATEDOCIIYESYANGONIN4040GLU1YESYANGONIN4040GLU1YESPHENYLAL3310LEU1YESANINEKCA540IIPHENYLALA310LEU1YESCOMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN					
DIHYDROM ETHYSTICI N4174 KCA L/MO LALA 5261YESBOUC EL/MO LISOLEUCIN ENO DOC KINGPINORESIN OL4740LEU L1YESOLKCA L/MO L514STIGMAST EROL5100ARG L1YESSTIGMAST EROL5100ARG L1YESMETHYLOL EANOLATENO LMETHYLOL LANONO LYANGONIN4040GLU L1YESPHENYLAL ANINE3310LEU L1YESPHENYLAL ANINE3310LEU L/MO L1YESCOMPOUN DS dockingDOC KINGINTER ACTINNO. OF INTER KINDOC KING	FFEATE				
ETHYSTICI NKCA L/MO526I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.I.	DUUDDOI				TIPO
NL/MOIIIISOLEUCINNOIIIBDOCDOCIIIPINORESIN4740LEU1YESOLKCA514IIL/MOIIYESSTIGMAST5100ARG1YESEROLLIYESEROLL/MOIIYESMETHYLOLNOIIYESEANOLATEDOCIIYESYANGONIN4040GLU1YESYANGONINLIYESPHENYLAL3310LEU1YESANINEKCA540IYESANINEL/MOIYESIOLNOIIYESANINES100LEU1YESANINEKCA540IIL/MOIIYESANINEBOCINTERNO. OFDOCIACTININTERKINGACTININTERKIN				1	YES
ICICICICICISOLEUCIN ENOICICICDOCDOCKINGICICPINORESIN OL4740LEU1YESOLKCA514ICICILICICICICSTIGMAST EROL5100ARG1YESEROLKCA501ICICL/MOICICICICMETHYLOLNOICICICMETHYLOLDOCICICICYANGONIN4040GLU1YESYANGONINLCICICICPHENYLAL3310LEU1YESANINEKCA540ICICPHENYLALA310LEU1YESANINEL/MOICICICCOMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN			526		
ISOLEUCIN ENO DOC KINGIIIPINORESIN OL4740LEU1YESOLKCA514IYESOLLIYESSTIGMAST5100ARG1YESEROLKCA501IYESEROLLIIYESMETHYLOLNOIIYESEANOLATEDOCIIYESYANGONIN4040GLU1YESYANGONIN4040GLU1YESPHENYLAL3310LEU1YESANINEKCA540IYESCOMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN	Ν	L/MO			
EDOCImage of the termDOCImage of termNINORESIN4740LEU1YESOLKCA514Image of termYESOLLImage of termImage of termYESOLLImage of termYESYESSTIGMAST5100ARG1YESEROLKCA501Image of termYESEROLKCA501Image of termImage of termMETHYLOLNOImage of termImage of termImage of termYANGONIN4040GLU1YESYANGONIN4040GLUImage of termImage of termYANGONIN4040GLUImage of termImage of termYANGONIN4040GLUImage of termImage of termYANGONIN4040GLUImage of termImage of termYANGONIN4040Image of termImage of termImage of termYANGONIN4040GLUImage of termImage of termYANGONINImage of termImage of termImage of termImage of term<		L			
KINGKINGIYESPINORESIN4740LEU1YESOLKCA514IIL/MOIIYESSTIGMAST5100ARG1YESEROLKCA501IYESEROLL/MOIYESEROLDOCIIMETHYLOLDOCIYESEANOLATEDOCIYESYANGONIN4040GLU1YESKCA527IIIL/MOIYESIIPHENYLAL3310LEU1YESANINEKCA540IYESL/MOIIYESANINEBOCINTERNO. OFDOCDS dockingKINGACTININTERKIN	ISOLEUCIN	NO			
PINORESIN OL4740LEU1YESOLKCA514L/MOLSTIGMAST5100ARG1YESEROLKCA501L/MOLMETHYLOLNOEANOLATEDOCYANGONIN4040GLU1YESKCA527L/MOPHENYLAL3310LEU1YESANINEKCA540L/MOLPHENYLALS10LEU1YESANINEKCA540L/MOLCOMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN	Е	DOC			
PINORESIN OL4740LEU1YESOLKCA514L/MOLSTIGMAST5100ARG1YESEROLKCA501L/MOLMETHYLOLNOEANOLATEDOCYANGONIN4040GLU1YESKCA527L/MOPHENYLAL3310LEU1YESANINEKCA540L/MOLPHENYLALS10LEU1YESANINEKCA540L/MOLCOMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN		KING			
OLKCA L/MO L514 LIntermediate LSTIGMAST5100ARG 5011YESEROLKCA L/MO501Intermediate LIntermediate NOIntermediate NOMETHYLOLNO LIntermediate NOCIntermediate NOIntermediate NOIntermediate NOMETHYLOLNO LIntermediate NOCIntermediate NOCIntermediate NOCIntermediate NOCMETHYLOLNO LIntermediate NOCIntermediate NOCIntermediate NOCIntermediate NOCYANGONIN4040GLU1YESYANGONIN4040GLU1YESYANGONINLIntermediate NOCIntermediate NOCYESPHENYLAL3310LEU1YESANINEKCA L/MO540Intermediate NOC OFIntermediate NOCCOMPOUNDOCINTER ACTINNO. OFDOCDS dockingKINGACTININTERKIN	PINORESIN		LEU	1	YES
L/MOL/MOIISTIGMAST5100ARG1YESEROLKCA501IIL/MOLIIIMETHYLOLNOIIIEANOLATEDOCIIYESYANGONIN4040GLU1YESKCA527IIYESL/MOIIYESPHENYLAL3310LEU1YESANINEKCA540IIL/MOIIYESANINEBOCINTERNO. OFDOCDS dockingKINGACTININTERKIN				-	120
LImage: lineImage: lineImage: lineSTIGMAST5100ARG1YESEROLKCA501Image: lineImage: lineL/MOImage: lineImage: lineImage: lineImage: lineMETHYLOLNOImage: lineImage: lineImage: lineYANGONIN4040GLU1YESYANGONIN4040GLU1YESImage: lineImage: lineImage: lineImage: lineYANGONIN4040GLU1YESMENNEImage: lineImage: lineImage: lineImage: linePHENYLAL3310LEU1YESANINEKCA540Image: lineImage: lineImage: lineImage: lineImage: lineImage: lineImage: lineImage: lineImage: lineImage: lineANINEImage: lineImage: line<	0L		511		
STIGMAST EROL5100 KCA L/MO LARG 501 L1YESMETHYLOL EANOLATENO LOCIIIYANGONIN4040 KINGGLU1YESYANGONIN4040 LGLU1YESYANGONIN4040 LGLU1YESYANGONIN4040 LGLU1YESYANGONIN4040 LGLU1YESYANGONIN4040 LGLU1YESYANGONIN4040 LGLU1YESYANGONIN4040 LGLU1YESYANGONINMOC LIYESYESPHENYLAL ANINE3310 LLEU1YESANINEKCA L/MO LS40IIYESCOMPOUN DS dockingMOC KINGINTER ACTINNO. OF INTERDOC					
EROLKCA L/MO L501 (IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	STICMAST		ADC	1	VEC
L/MOL/MOInternationMETHYLOLNOInternationEANOLATEDOCInternationMETHYLOLNOInternationEANOLATEDOCInternationYANGONIN4040GLU1YANGONIN4040GLU1YANGONIN4040GLU1YANGONIN4040GLU1YANGONIN4040GLU1YESKCA527InternationPHENYLAL3310LEU1ANINEKCA540InternationL/MOInternationInternationCOMPOUNDOCINTERNO. OFDS dockingKINGACTININTER			-	1	IES
LImage: LImage: LMETHYLOLNOImage: LImage: LEANOLATEDOCImage: LImage: LYANGONIN4040GLU1YESYANGONIN4040GLU1YESKCA527Image: LImage: LImage: LPHENYLAL3310LEU1YESANINEKCA540Image: LImage: LLImage: LImage: LImage: LImage: LCOMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN	EROL		501		
METHYLOL EANOLATENO DOC KINGImage: stress of the stres					
EANOLATEDOC KINGIIYANGONIN4040GLU1YESYANGONIN4040GLU1YESKCA527IIIL/MOIYESIIPHENYLAL3310LEU1YESANINEKCA540IIL/MOIIYESANINEKCA540IIDCINTERNO. OFDOCDS dockingKINGACTININTERKIN					
KINGKINGYANGONIN4040GLU1YESKCA527IIL/MOIYESLIYESPHENYLAL3310LEU1YESANINEKCA540IYESL/MOIIYESANINEKCA540IILIDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN	METHYLOL	NO			
YANGONIN4040GLU1YESKCA527IIL/MOIIYESPHENYLAL3310LEU1YESANINEKCA540IIL/MOIIIYESANINEKCA540IILIIIIICOMPOUNDOCINTERNO. OFDOCDSdockingKINGACTININTERKIN	EANOLATE	DOC			
YANGONIN4040GLU1YESKCA527IIL/MOIIYESPHENYLAL3310LEU1YESANINEKCA540IIL/MOIIIYESANINEKCA540IILIIIIICOMPOUNDOCINTERNO. OFDOCDSdockingKINGACTININTERKIN		KING			
KCA L/MO L527 LIntermediate LPHENYLAL ANINE3310 KCALEU 5401YESL/MO LL1YESCOMPOUN DS dockingDOC KINGINTER ACTINNO. OF INTERDOC KING	YANGONIN		GLU	1	YES
L/MOLIIPHENYLAL3310LEU1YESANINEKCA540IIL/MOLIIICOMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN					
LImage: constraint of the systemPHENYLAL3310LEU1YESANINEKCA540Image: constraint of the systemImage: constraint of the systemYESL/MOLImage: constraint of the systemImage: constraint of the systemImage: constraint of the systemYESCOMPOUNDOCINTERNO. OFDOCDSdockingKINGACTININTERKIN					
PHENYLAL ANINE3310 KCALEU 540 L1YESCOMPOUN DS dockingDOC KINGINTER ACTINNO. OF INTERDOC KING					
ANINE KCA 540 L/MO L DC INTER NO. OF DOC DS docking KING ACTIN INTER KIN	DUENVI AI		IEU	1	VES
L/MO L COMPOUN DOC INTER NO. OF DOC DS docking KING ACTIN INTER KIN				1	IES
LImage: COMPOUNDOCINTERNO. OFDOCDS dockingKINGACTININTERKIN	AININE		340		
COMPOUNDOCINTERNO. OFDOCDSdockingKINGACTININTERKIN					
DS docking KING ACTIN INTER KIN					
8					
with SCO G ACTIO G	DS docking		ACTIN		
	with	SCO	G	ACTIO	G

# © IJPMN, Volume 3, Issue 2, August-2016



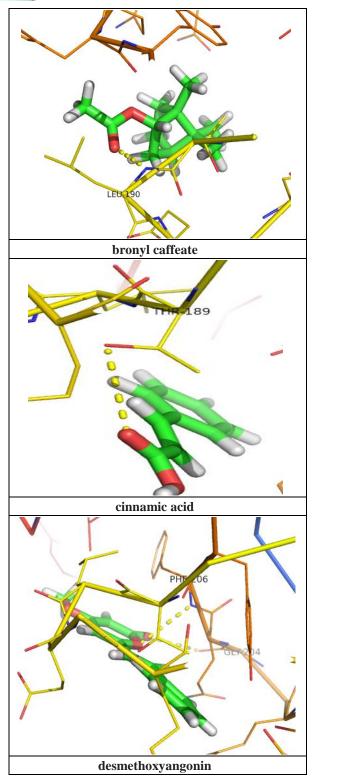
DYX1C1	RE	AMIN	NS	(YES
receptor	KCA	0		/NO)
-	L/MO	ACIDS		
	L			
DIHYDROK	NO			
AVAIN	DOC			
	KING			
SCHIZAND	3258	ASN	1	YES
RIN	KCA	339		
	L/MO			
	L			
METHYSTI	2686	ARG	1	YES
CIN	KCA	365	1	
	L/MO	ASN		
	L	363		
VALERANO	NO			
NE	DOC			
	KING			
METHYLOL	NO			
EANOLATE	DOC			
	KING			
DIHYDROM	3314	LYS	1	YES
ETHYSTICI	KCA	408		
Ν	L/MO			
DODODUU	L	ADC	1	VEC
PODOPHYL	3616	ARG	1	YES
LOTOXIN	KCA	371 TUD	1	
	L/MO L	THR		
KAVAIN		374 ASP	1	YES
KAVAIN	2528 KCA	ASP 396	1	IES
	L/MO	390		
	L/MO L			
DEOXYSCH	L NO			
IZANDRIN	DOC			
	KING			
ISOLEUCIN	2046	ARG	2	YES
E	KCA	371	2	110
-	L/MO	5,1		
	L			
GOMISIN	2866	ASN	1	YES
	KCA	339	-	120
	L/MO			
	L			
YANGONIN	3202	LYS	1	YES
	KCA	367		
	L/MO			
	L			
ALLANTOI	1980	ARG	1	YES

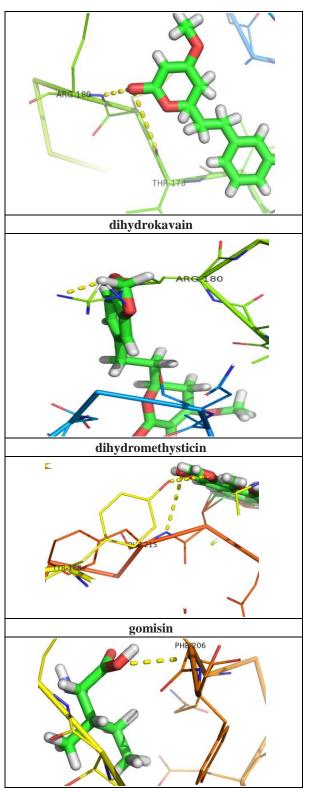
N	KCA L/MO L	365		
BORNYLCA FFEATE	2500 KCA L/MO L	ARG 365	1	YES
DESMETHO XYANGONI N	2934 KCA L/MO L	LYS 349	1	YES
CINNAMIC ACID	NO DOC KING			
STIGMAST EROL	4268 KCA L/MO L	ASN 361	1	YES
PHENYLAL ANINE	2212 KCA L/MO L	ASP 396	2	YES
ROSMARIN IC ACID	3598 KCA L/MO L	TYR 306 LYS 408 ARG 371	1 1 1	YES
PINORESIN OL	3854 KCA L/MO L	LYS 322	1	YES



# © IJPMN, Volume 3, Issue 2, August-2016

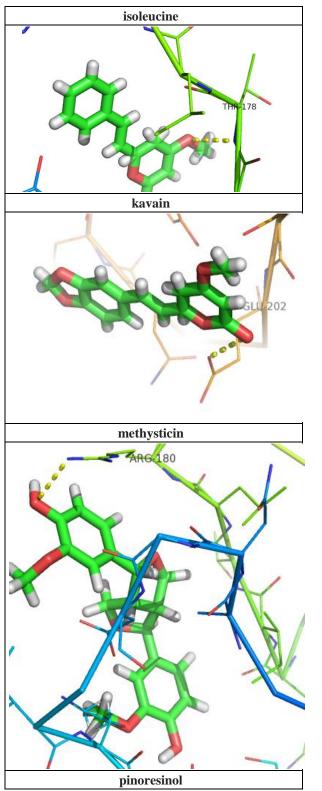


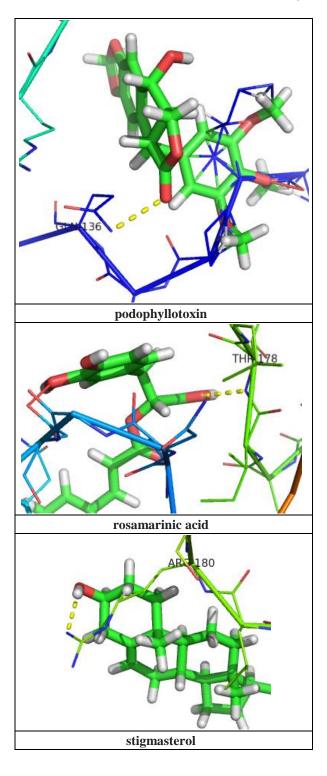




# © IJPMN, Volume 3, Issue 2, August-2016

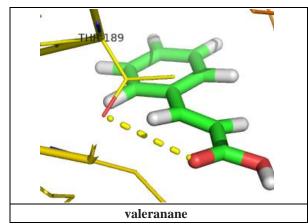


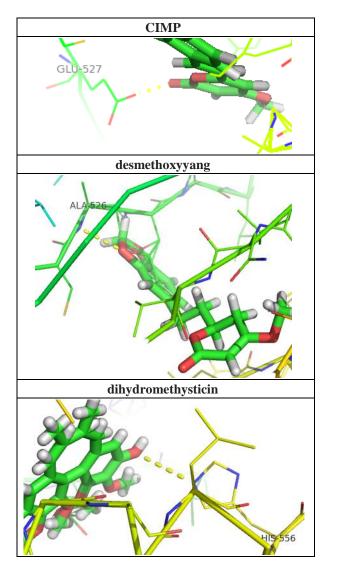


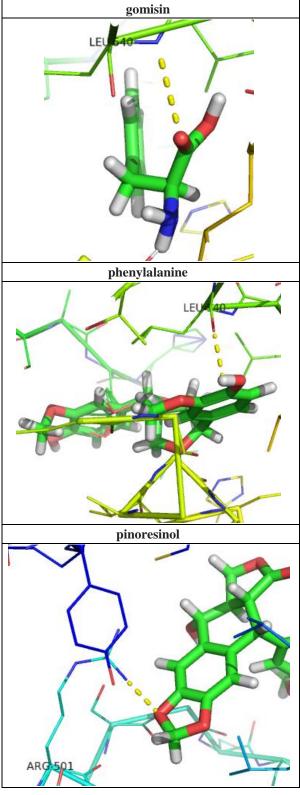


# © IJPMN, Volume 3, Issue 2, August-2016



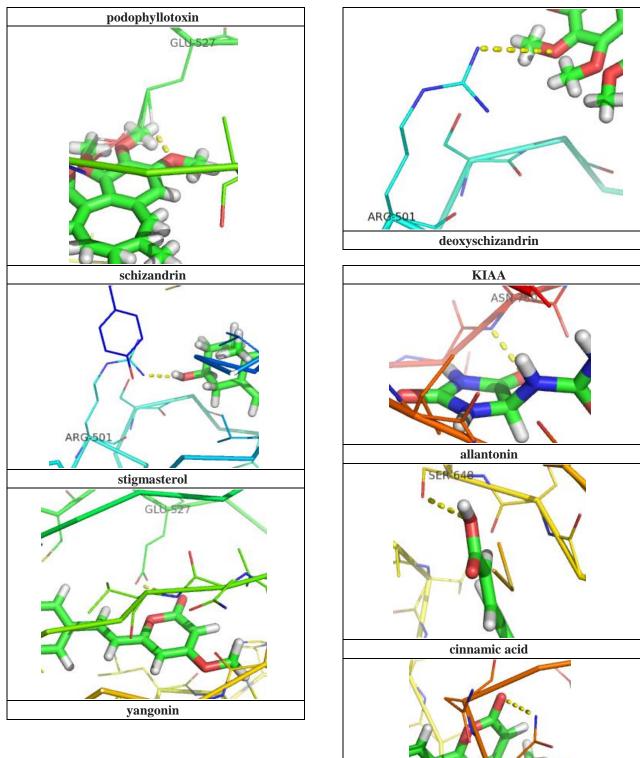






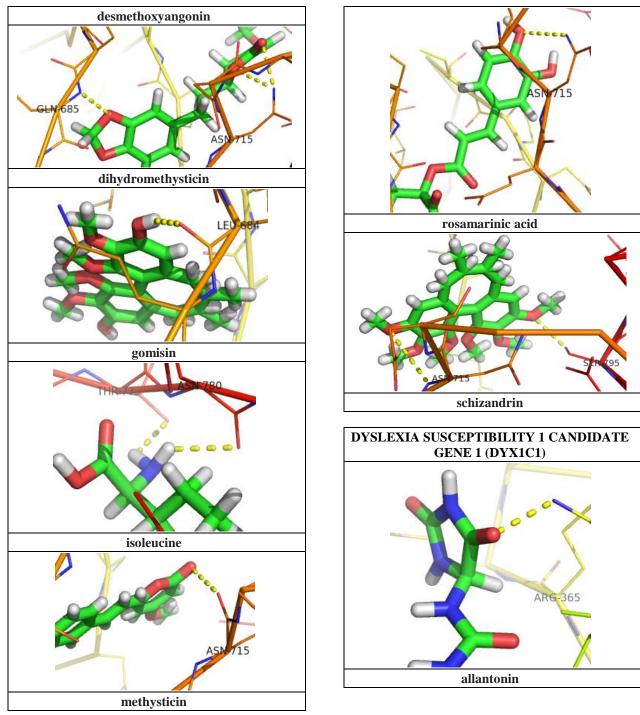
# © IJPMN, Volume 3, Issue 2, August-2016





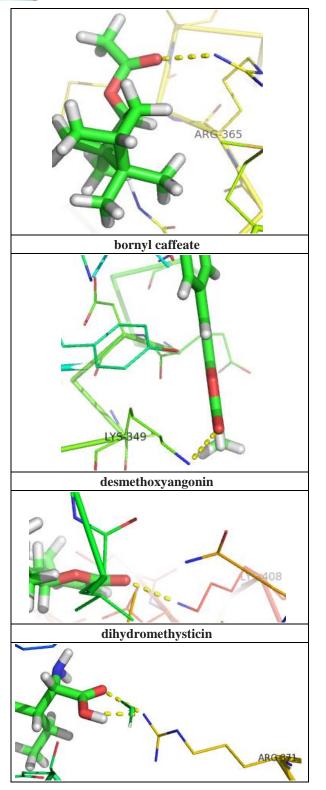
# © IJPMN, Volume 3, Issue 2, August-2016

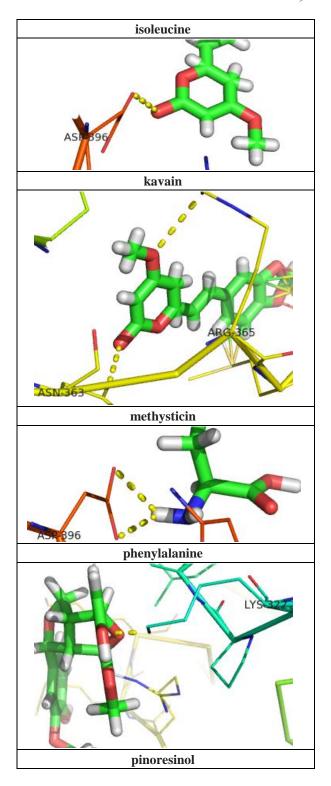




# © IJPMN, Volume 3, Issue 2, August-2016







# © IJPMN, Volume 3, Issue 2, August-2016



IV

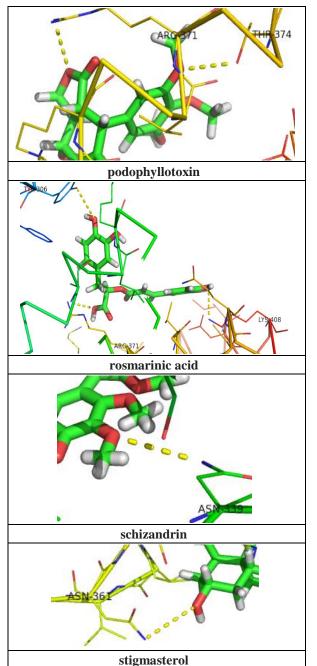


Fig. 1: Docking images of the dyslexia receptors with the active compounds of the CNS herbs

It is seen that DCDC2 best interacts with desmethoxyangonin, dihydrokavain and gomisin. It is seen that KIAA best docks with schizandrin, dihydromethysticin and isoleucine. It is seen that CMIP docks with gomisin, podophyllotoxin, schizandrin, desmethoxyangonin, pinoresinol, stigmasterol, yangonin and phenylalanine.

It is seen that DYX1C1 docks best with methysticin, podophyllotoxin, isoleucine, phenylalanine and rosmarinic acid and has a good docking score and interaction with desmethoxyangonin.

#### CONCLUTION

It is seen that the compound desmethoxyangonin docks with all the receptors and has good interaction with all the receptors and hence selected as best ligand for dyslexia receptor proteins.

#### **REFERENCES:**

- [1] Hannula-Jouppi K, Kaminen-Ahola N, Taipale M, Eklund R, Nopola-Hemmi J, Kääriäinen H, Kere J, 2005, The Axon Guidance Receptor Gene *ROBO1* Is a Candidate Gene for Developmental Dyslexia, PLoS Genet. Oct 2005; 1(4): e50.
- [2] Nagase T, Ishikawa K, Nakajima D, Ohira M, Seki N, Miyajima N, Tanaka A, Kotani H, Nomura N, Ohara O (April 1997). "Prediction of the coding sequences of unidentified human genes. VII. The complete sequences of 100 new cDNA clones from the brain which can code for large proteins in vitro". *DNA Res.* 4 (2): 141– 50.
- [3] Scerri\_ TS, Morris AP, Buckingham LL, Newbury DF, Miller LL, Monaco AP, Bishop DV, Paracchini S, 2011, DCDC2, KIAA0319 and CMIP are associated with reading-related traits, Biol Psychiatry., 1;70(3):237-45.
- [4] Meng, H., Smith SD, Hager K, Held M, Liu J, Olson RK, Pennington BF, DeFries JC, Gelernter J, O'Reilly-Pol T, Somlo S, Skudlarski P, Shaywitz SE, Shaywitz BA, Marchione K, Wang Y, Paramasivam M, LoTurco JJ, Page GP, Gruen JR (2005). DCDC2 is associated with readingdisability and modulates neuronal development in the brain.Proceedings of the National Academy of Science of the United StatesofAmerica,102,17053–17058.
- [5] Weissfuss J, Kirsten H, Wolfram G, Boltze J and Ahnert P, (2009) The role of gene DCDC2 in German dyslexics.Ann. of Dyslexia, doi:10.1007/s11881-008-0020-7.
- [6] ParacchiniSSteer CD, Buckingham LL, Morris AP, Ring S, Scerri T, Stein J, Pembrey ME, Ragoussis J, Golding J, Monaco AP, 2008, Association of the KIAA0319 dyslexia susceptibility gene with reading skills in the general population. Am J Psychiatry. 165(12):1576-84.
- [7] Levecque C, Velayos-Baeza A, Holloway ZG, Monaco AP (July 2009). "The dyslexia-associated protein KIAA0319 interacts with adaptor protein 2 and follows the classical clathrin-mediated endocytosis

## © IJPMN, Volume 3, Issue 2, August-2016



pathway". Am. J. Physiol., Cell Physiol. 297 (1): C160-8.

- [8] Cope N, Harold D, Hill G, Moskvina V, Stevenson J, Holmans P, Owen MJ, O'Donovan MC, Williams J (April 2005). "Strong evidence that KIAA0319 on chromosome 6p is a susceptibility gene for developmental dyslexia". *Am. J. Hum. Genet.* **76** (4): 581–91.
- [9] Zhang Y,Li J,TardifT,Burmeister M, Villafuerte SM, Chang CM,LiH,Shi B, Liang W, Zhang Z, Shu H, 2012, Association of the *DYX1C1* Dyslexia Susceptibility Gene with Orthography in the Chinese Population, PLoS ONE 7(9): e42969.
- [10] T. Fagerheim, P. Raeymaekers, F. E. Tonnessen, M. Pedersen, L. Tranebjarg, and H. Lubs, 1999, A new gene (DYX3) for dyslexia is located on chromosome 2, J Med Genet., 36(9):664-9.
- [11] Grimbert P, Valanciute A, Audard V, Pawlak A, Le gouvelo S, Lang P, Niaudet P, Bensman A, Guellaën G, Sahali D, 2003, "Truncation of C-MIP (TC-MIP), a new proximal signaling protein, induces c-maf Th2 transcription factor and cytoskeleton reorganization", J Exp Med.198(5):797-807.

- [12] Canel, C; Moraes, RM; Dayan, FE; Ferreira, D
  (2000). "Molecules of Interest: Podophyllotoxin". *Phytochemistry* 54 (2): 115–120.
- J. L. Hartwell; A. W. Schrecker (1951).
  "Components of Podophyllin. V. The Constitution of Podophyllotoxin". *Journal of the American Chemical Society* 73 (6): 2909–2916.
- [14] Yang CB, Pei WJ, Zhao J, Cheng YY, Zheng XH, and Rong JH, 2014, "Bornyl caffeate induces apoptosis in human breast cancer MCF-7 cells via the ROS- and JNK-mediated pathways", Acta Pharmacol Sin. 35(1): 113–123.
- [15] Davin, Laurence B.; Bedgar, Diana L.; Katayama, Takeshi; Lewis, Norman G. (1992). "On the stereoselective synthesis of (+)-pinoresinol in Forsythia suspensa from its achiral precursor, coniferyl alcohol". Phytochemistry **31** (11): 3869–74.
- [16] Davin, Laurence B.; Bedgar, Diana L.; Katayama, Takeshi; Lewis, Norman G. (1992). "On the stereoselective synthesis of (+)-pinoresinol in Forsythia suspensa from its achiral precursor, coniferyl alcohol". Phytochemistry **31** (11): 3869–74.

#### © IJPMN, Volume 3, Issue 2, August-2016