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(88) Date of publication of the international search report:
8 October 2009

(54) Title: HEMAGGLUTININ POLYPEPTIDES, AND REAGENTS AND METHODS RELATING THERETO

(57) Abstract: The present invention provides a system for analyzing interactions between glycans and interaction partners that bind to them. The present invention also provides HA polypeptides that bind to umbrella-topology glycans, and reagents and methods relating thereto.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/30058

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C07H 21/04 (2009.01)

USPC - 536/23.5

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - C07H 21/04 (2009.01)

USPC - 536/23.5; 514/2, 514/12, 424/130.1; 530/380, 530/387.1, 435/320.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

IPC(8) - C07H 21/04 (2009.01) - see keyword below

USPC - 536/23.5; 514/2, 514/12, 424/130.1; 530/380, 530/387.1, 435/320.1 - see keyword below

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWEST(USPT,PGPB,EPAB,JPAB); Medline, Google

Search terms: umbrella, topology, glycan, 2-6 sialylated glycan, compete, HA, hemagglutinin, expression, human, 18SC, Avian, \$2-6-linked, \$2-3-linked, adapted, A/South Carolina/1/1918, affinity, Gamblin structure, receptor, influenza, Tumpey, two-amino, 1918

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	STEVENS et al. Glycan Microarray Analysis of the Hemagglutinins from Modern and Pandemic Influenza Viruses Reveals Different Receptor Specificities. J. Mol. Biol. 2006, Vol. 355, p.1143]-155. Abstract; pg 1144, col 2, mid para; pg 1149, col 2, para 2 and 3; and pg 1153, col 1, para 1	1-15
X	YANG et al. Immunization by Avian H5 Influenza Hemagglutinin Mutants with Altered Receptor Binding Specificity. Science, 2007, Vol. 317, p. 825-828. Abstract; pg 825, col 3; and pg 826, col 1, para 1	16-27
A	TUMPEY et al. A Two Amino Acid Change in the Hemagglutinin of the 1918 Influenza Virus Abolishes Transmission. Science, 2007, Vol. 315, p.655-659	1-27
A	GAMBLIN et al. The Structure and Receptor Binding Properties of the 1918 Influenza Hemagglutinin. Science, 2004, Vol. 303, p. 1838-1842.	1-27

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

09 June 2009 (09.06.2009)

Date of mailing of the international search report

25 JUN 2009

Name and mailing address of the ISA/US

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/30058

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 145-147
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-27 are drawn to either an engineered binding agent that binds to umbrella-topology glycans, or an isolated binding agent that binds to umbrella-topology glycans, wherein the binding agent is not an H1 protein from the recited naturally occurring binding agents.

Group II: Claims 28-31 are drawn to either an antibody that binds to an engineered binding agent that binds to umbrella-topology glycans, or an antibody that binds to an isolated binding agent that binds to umbrella-topology glycans, wherein the binding agent is not an H1 protein from the recited naturally occurring binding agents.

*****Continued in extra sheet*****

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
Claims 1-27

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/30058

Continuation of:

Box No III (unity of invention is lacking)

Group III: Claim 32 is drawn to a viral particle including an engineered binding agent that binds to umbrella-topology glycans.

Group IV: Claims 33 and 37-108 are drawn to either a method of treating influenza infection, or a method of any of, inhibiting, in a subject, binding of an influenza virus to a hemagglutinin receptor having an umbrella topology.

Group V: Claim 34-36* and 135 are drawn to either a glycan array, a method of use thereof, or a method of evaluating a test binding agent.

Group VI: Claims 109-134 are drawn to a method of selecting a subject for treatment.

Group VII: Claim 136-144 and 148-156 are drawn to either a device containing a blocking agent and configured to administer a dose, a kit comprising a unit dose of a binding agent, or a pharmaceutical composition.

The groups listed above do not relate to a single general inventive concept under PCT Rule 13.1 because under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons.

The technical feature that links the listed Groups is an uncommon or engineered binding agent that binds to umbrella-topology glycans. However, this does not represent an improvement over the prior art of Steven et al. ("Glycan Microarray Analysis of the Hemagglutinins from Modern and Pandemic Influenza Viruses Reveals Different Receptor Specificities" J. Mol. Biol. (2006) 355, 1143-1155) who teach an engineered binding agent (mutant HA) that binds to umbrella-topology glycans (receptors with alpha 2,6 sialic acid linkage; pg 1149, last paragraph to pg 1150 first paragraph and the abstract).

Accordingly, unity of invention is lacking under PCT Rule 13 because the groups do not share a same or corresponding special technical feature providing a contribution over the prior art.

*Claim 35 is drafted as a dependent of claim 26; however, claim 35 has been interpreted as a dependent of claim 34 in order to provide antecedent basis for "the glycan array".

Continued from Item 4 of the first sheet (unsearchable claims): Claims 145-147 have been held unsearchable because they are multiple dependent claims and not drafted in accordance with PCT Rule 6.4(a).