Claims

1. CLAIMS

A method for producing a vaccine for use in the treatment or prevention of *P. acnes*-associated infections,polypeptide comprising

- selecting at least one antigen comprising at least one *P. acnes* epitope, wherein the *P. acnes* epitope is an epitope which is directly accessible to human serum antibodies when presented by the live *P. acnes* bacterium and the specific binding of the epitope by the human immune system leads to reduction of bacterial numbers, fitness, growth, virulence or a combination thereof, especially the reduction of bacterial numbers,

wherein binding of the epitope by the immune system, especially by the human immune system, is evidenced by using a flow cytometry assay, preferably by fluorescence-activated cell sorting (FACS) assay;

and

wherein reduction of bacterial numbers, fitness, growth, virulence or a combination thereof is evidenced by an opsonophagocytic killing assay (OPK) in the presence of antibodies specific for the at least one antigen comprising at least one *P. acnes* epitope.

2. A method for producing a vaccine for use in the treatment or prevention of *P. acnes*-associated infections, comprising

- selecting at least one antigen comprising at least one *P. acnes* epitope, wherein the *P. acnes* epitope is an epitope which is directly accessible to human serum antibodies when presented by the live *P. acnes* bacterium and the specific binding of the epitope by the human immune system leads to reduction of bacterial numbers, fitness, growth, virulence or a combination thereof, especially the reduction of bacterial numbers,

wherein binding of the epitope by the immune system, especially by the human immune system, is evidenced by antibody binding to *P. acnes* bacteria using a flow cytometry assay, preferably by fluorescence-activated cell sorting (FACS) assay, and by binding of antigen-specific antibodies to live *P. acnes* bacteria in the flow cytometry assay;

and

wherein reduction of bacterial numbers, fitness, growth, virulence or a combination thereof is evidenced by an opsonophagocytic killing assay (OPK), wherein said OPK assay shows at least 50% more reduction compared to negative control in an at least two-fold higher dilution as used in the opsonophagocytic killing assay for K_{50} titer determination, of bacterial cell counts in a reaction sample, after an incubation of at least 24h or longer at 37°C, in the presence of 5% CO_2, using at least

two serial two-fold dilutions of a polyclonal human antibody specific for the at least one antigen comprising at least one P. acnes epitope, or human serum containing such antibodies, or an antigen induced polyclonal antibody serum; starting at a complement-inactivated serum dilution of at least 1/200.

3. Method according to claim 1 or 2, wherein the OPK assay is performed

- without the presence and/or addition of antibiotic compounds and/or

- without the presence and/or addition to complement and/or complement factors.

4. Method according to any one of claims 1 to 3, wherein the OPK assay is perfomed with the use of phagocytes, preferably neutrophils, granulocytes, macrophages, monocytes, and/or other cells capable of uptake and killing of *P. acnes* bacteria, especially neutrophils or granulocytes.

1. 5. A vaccine comprisinga Dermatan sulfate-binding adhesin 1 of P. acnes (DsA1 polypeptide) and/or), or a fragment or derivative thereof, and at least a Dermatan sulfate-binding adhesin 2 of P. acnes (DsA2 polypeptide), and/), or a fragment and/or a derivative ofthereof, said DsA1 orand DsA2, wherein DsA1 and DsA2 comprise comprising from N- to C-terminus an N-terminal swapping region ("NSR"), a first conserved sub-domain ("CSD1"), a first swapping region ("SR1"), a second conserved sub-domain ("CSD2"), a second swapping region ("SR2"), a third conserved sub-domain ("CSD3"),"); and, optionally a Pro-ThrLeu repeat containing region ("PT repeat region"), and a C-terminal region ("CTR"), wherein the fragment and/or the derivative comprises or consists at least of a CSD2 fragment, wherein the CSD2 fragment is preferably;

- a contiguous wherein the polypeptide sequencecomprises at least CSD1, CSD2 or CSD3 of phenylalanine 150 (F150) to leucine 184 (L184),

- a contiguous polypeptide sequence of phenylalanine 150 (F150) to leucine 267 (L267),

- a contiguous polypeptide sequence of leucine 238 (L238) to leucine 272 (L272), or

- a contiguous polypeptide sequence of histidine 218 (H218) to leucine 267 (L267),

with the proviso that the fragment or derivative does not comprise an NSRDsA1 and a CTR,at least CSD1, CSD2 or CSD3 of DsA2,

and wherein the amino acid numbering corresponds to the amino acid sequence Q6A5X9 in the UniProt database,

wherein the DsA1 domains are defined as follows: NSR: from S29 to I48, CSD1 from I49 to L130, SR1 from G131 to S147, CSD2 from A148 to L267, SR2 from A268 to T277, CSD3 from A278 to K323, the PT repeat region from P324 to T361, and CTR from S362 to F405 in the sequence of Q6A5X9 or any other functional DsA1 sequence comprising all these domains, especially the DsA1 sequences of Fig.12 comprising all these domains;of the UniProt database (SEQ ID NO: 64);

and/or wherein the DsA2 domains are defined as follows: NSR: from A72 to K92, CSD1 from I93 to L174, SR1 from S175 to S191, CSD2 from A192 to L311, SR2 from A312 to T321,

CSD3 from A322 to E366, the PT repeat region from P367 to T420, and CTR from H421 to A463 in the sequence of Q6A5P9 or any other functional DsA2 sequence comprising all these domains, especially the DsA2 sequences of Fig.12 comprising all these domains. of the UniProt database (SEQ ID NO: 65).

2. 6. Vaccine according to The polypeptide of claim 51, wherein the polypeptide comprises an amino acid exchange at one or more of C53, C319 and C321 of DsA1, and C97 and C363 of DsA2, if present in the polypeptide, preferably one or more of amino acid exchanges C53S, C319S and C321P of DsA1 and C97S and C363S of DsA2.

3. The polypeptide of claim 1 or 2, comprising at least two of CSD1, CSD2 and CSD3 of DsA1 or DsA2.

4. The polypeptide of any one of claims 1-3, wherein
(i) the DsA1, or a fragment or the derivative thereof, and/or the DsA2, or a fragment or derivative thereof, comprises or consists at least of a CSD2; and/or
(ii) in the fragment or derivative of DsA1 and/or DsA2 at least 5 PT repeats, preferably at least 10 PT repeats, especially at least 15 PT repeats, are deleted compared to a naturally occurring wild type DsA1 or DsA2 polypeptide, and wherein preferably at least one, more preferred at least two, more preferred at least three, even more preferred at least four, especially five, PT repeat(s) is/are present.

5. The polypeptide of any one of claims 1-4, wherein the polypeptide comprises any one of:
(a) (i) a CSD2 fragment of DsA1 or DsA2 within A148 to L267 of DsA1 or A192 to L 311 of DsA2, at least comprising a contiguous polypeptide sequence of phenylalanine 150 (F150) to leucine 184 (L184), preferably of DsA1 or F194 to L228 of DsA2; or
(ii) a CSD2 derivative of (a)(i) with one or more, preferably one, two or three, especially one, of the following amino acid exchanges: A149T, D152N, D152S, V155I, V163I, K166H, K166P, A168T, K169R, T171A, V173M, A176V, A183T, T190F, T190I, E 191K, A192L, A192F, A198G, A199T, A202T, V205I, G206N, G206S, G206R, G206Q, K212Q, A214T, I219V, I219A, S223A, D225N, V233I, S235F, N239S, L255I, V257I, Q258S, I259L, R262H, I264V, D265K in DsA1 and T193A, N196D, N196S, I199V, I207V, H210K, H210P, A212T, R213K, T215A, V217M, V220A, T227A, F234T, F234I, E 235K, L236A, L236F, A242G, A243T, A246T, I249V, R250G, R250S, R250N, G250Q, Q256K, A258T, V263I, V263A, A267S, D269N, I277V, S279F, S283N, I299L, I301V, S302Q, L303I, H306R, V308I, K309D in DsA2;
(b) (i) a CSD1 fragment of DsA1 or DsA2 within I49 to L130 of DsA1 or I93 to L174 of DsA2, at least comprising a contiguous polypeptide sequence of phenylalanine 150 (F150) to isoleucine 193 (I193),20 amino acid residues, especially T117 to A127 of DsA1 or T161 to LA171 of DsA2; or
(ii) a CSD1 derivative of (b)(i) with one or more, preferably one, two or three, especially one, of the following amino acid exchanges: D50N, D50S, K51E, K51A, C53Y, D55K, V57I, A61L, A65G, A68V, L71M, F76L, S78A, V82M, V82A, L84M, P86R, P86S, K90R, K90A, K94A, V97T, L99T, I100L, K104R, K106E, A107V, I109V, G110A, A111S, L113V, G114S, L116V, T117A, K120A, I121V, R123H, A124T, V128I in DsA1 and S94D, S94N, E95A, E95K, C97Y, K99D, I101V, L105A, G109A, V112A, L115M, L120F, A122S, A126M, A126V, L128M, P130R, P130S, A134K, A134R, A138K, T141V, T143L, I144L, R148K, K150E, V151A, V153I, A154G, S155A, L157V, G158S, V160L, A161T, A164K, V165I, H167R, A168T, I172V in DsA2; and/or
(c) (i) a CSD3 fragment of DsA1 or DsA2 within A278 to K323 of DsA1 or A322 to E366 of DsA2, at least comprising a contiguous polypeptide sequence of phenylalanine

~~150 (F150) to leucine 267 (L267),~~ R266 to T277 or R286 to K296 of DsA1 or V333 to Q347 of DsA2; or

- ~~a contiguous polypeptide sequence of leucine 238 (L238) to leucine 272 (L272), or~~
- ~~a contiguous polypeptide sequence of histidine 218 (H218) to leucine 267 (L267).~~

~~7. A vaccine comprising the putative iron-transport protein of *P. acnes* (PITP polypeptide) and/or a fragment and/or or a derivative of PITP, wherein PITP~~(ii) a CSD3 derivative of (c)(i) with one or more, preferably one, two or three, especially one, of the following amino acid exchanges:
M281V, N283D, T285A, R286Q, V289A, V291I, I292R, T293N, A294T, D295K, D295Q, K296E, I298V, K299A, T300V, T300I, A301Y, gap between 301 and 302 D, E302K, E305K, K306A, A310T, D313G, K316Q, S320T, C321-, P322L, K323D, K323E in DsA1 and V325M, D327N, A329T, R330Q, V333A, I335V, R336I, N337T, T338A, Q339K, Q339D, E340K, I342V, A343K, V344T, V344I, Y345A, K346E, K349E, A350K, T354A, G357D, Q360K, T364S, P365L, E366D, E366K, in DsA2.

6. The polypeptide of any one of claims 1-5, wherein the polypeptide comprises or consists of a sequence according to any one of SEQ ID NO: 44-50, e.g. according to SEQ ID NO:49, optionally wherein
(i) the polypeptide lacks an N-terminal methionine residue;
(ii) the polypeptide comprises one or more, preferably one, two or three, especially one, of the following amino acid exchanges compared to SEQ ID NO: 49:
A274Y, S26C, S26L, A274F, S26I, G119H, A274L, A274W, S26V, S26M, S212L, T108I, A134L, S26F, N130V, A229L, A274I, G194F, S26W, A291F, G181I, A229I, E278I, A175L, G181L, A152L, A274V, N130L, E278V, K46I, E278L, E278A, K46C, K46L, K93L, K93V, E164I, E278C, E164V, E278M, N130I, K46V, R221C, K93C, K46M, S51L, K93I, E278F, K93M, E164A, S51I, R221L, P209L, K46F, S51V, E164C, R221I, E164M, K93F, D137L, P209V, E164L, P59L, R221F, N130C, S51C, R221G, E278T, K46G, P59V, K46A, N130M, E278G, D137V, K46T, P209C, P59I, P209I, T144L, N130F, E164F, S51F, R221M, P209F, S51M, R221S, P209A, K93A, P209M, E164Y, D137C, R221A, P115C, P59F, S208A, K46S, P115V, A134I, P115A, S212V, N249L, E278S, D137F, D137M, P115L, S212I, R221V, N249V, D137I, E278Y, G194L, P59M, R221T, A188L, N249I, T144I, E164T, S208C, S208V, D137A, K46Y, K93G, G87I, E164G, K46P, P59C, A97V, S212C, G83L, K93T, N249C, A134V, G83V, T108V, T112L, T144V, A100L, G87V, E164W, E164S, A171L, A97L, A188F, K93W, T90I, A174I, K93Y, A111L, A97I, N130A, G48I, E278W, R221Y, G135L, T112V, F197V, T144F, K93S, G194V, G87A, A188V, T144C, K46N, P115M, A175I, N130T, S51A, G194C, G48L, G104V, A174V, G158V,T90V, R221N, A202L, A39L, A134F, D137Y, G158I, A174L, P155V, A171V, S51T,F197I, T112C, D137W, G135V, D137G, P115G, T250C, S208L, A100I, T250L, T144M, T108C, P115F, G69L, T112F, G181F, A100F, S208I, G223V, T250V, N249M, A111V, N249Y, A111F, A188M, A111I, P209Y, A175V, P155I, N130G, S120V, A111C, A100C, A97F, G194M, G69I, E278Q, S208G, G181C, G87F, G48V, A97C, I205L, G194I, D137T, S51G, F197C, G223L, N249A, S51Y, P115S, A202I, P155C, S26A, G83M, S120C, D137S, E278N, G83F, G158C, P59Y, G87C, G87M, N130S, P115I, A202F, A100M, G83C, S212M, A39V, A188I, F197L, G181M, A134C, P115T, A174F, K93P, P209W, P209G, P59A, A39C, G104I, T250G, S208F, R221Q, G181A, G104C, T90C, K46Q, P209T, K46W, A171I, G158A, A134M, G48C, G194A, T90A, T90M, N130Y, N249F, A172L, A152V, A152I, P59W, R221P, G158F, T112M, G135M, G181V, G104L, S208T, N249W, A97M, G135F, K93Q, G42L, A111M, G104A, E278P, T90L, R221D, A175C, A188C, A291L, S212A, F123L, T250I, A174C, E164Q, P155L, A174M, G158M, A172V, E164N, A168L, T90F, A39F, G42V, I205F, A39M, N249G, A175F, G135C, A171F, S212F, K46D, A100Y, G42I, P59G, G69A, E164P, G158L, G42C, A171C, T250M, T108L, K93N, A171M, G223I, A175M, T108M, A172I, S51P, A291I, A111Y, G20V, S120I, P59T, A58I, G223C, S208M, G48M, K46H, A62L, A43I, T250A,

N130W, G194Y, R221H, D137P, N249S, G104F, A100V, F123I, A172C, T112I, G69F, P115Y, P59S, A100W, G104M, G69C, R221W, K93H, A204L, G20L, G223F, A168I, D28K, E275K, K77R, D17R, H76D, H75D, H76E, K77D, H75E, P294D, S293D, S293E, D286E, P294E, S292E, D285E, H76R, K77E, K289R, P295D, D285K, R179E, H75R, P295E, P294R, P294K, D286K, D285R, S293R, S293K, R180D, R180K, H183E, R179K, K289E, R180E, A98K, R179D, A99K, S292D, D286R, K290D, H75K, A99E, N256E, K290E, K290R, R239D, A199K, A200K, K255E, H183D, A99R, H235E, A98R, D102K, and A200R; and/or

(iii) the polypeptide has at least about 90% amino acid sequence identity, preferably at least 95%, more preferably at least 98%, more preferably at least 99% or at least 99.5%, relative to the amino acid sequence of the corresponding portion of the respective naturally occurring *P. acnes* antigen.

7. The polypeptide of any one of claims 1-6, wherein the DsA1 or the fragment or derivative thereof and/or the DsA2 or the fragment or derivative thereof comprises one or more, preferably one, two or three, especially one, of the following amino acid exchanges:
DsA1: A301Y, G206L, G206F, A192L, G206R, G206W, G206Q, G206K, A301F, A301L, G206I, A301W, A301I, G206E, G206M, G208L, G206V, A192M, A256L, A192I, A68I, G206N, A68V, I259L, A161L, V205I, G206T, G206H, A68L, G206Y, A256I,G206A, 68M, A192F, G110A, N239L, G206C, A301V, E305L, A93I, A93L, S223A,E305I, E305V, E305A, K120V, K120L, N157I, K120C, E305C, E305M, N239I, K120I, R248C, N239V, E191I, E305F, S78I, K120M, E191L, R248L, H146V, E191V, H146I, S78L, S78V, N157V, H146C, K120F, R248I, R248M, D164L, P236V, P236L, H146L, H146F, D164I, H146M, P86L, R248G, N239C, N157C, E305T, E191C, S78C, R248F, G221L, E305G, P236F, T171L, P86V, R248S, N157L, K120A, H146A, P86I, N157F, S235A, R248A, E191M, N157M, A124I, P236A, S78F, P236C, S78M, A161I, N239M, T171I, E191F, S235V, P86F, H146G,S223I, E305S, D164F, E305Y, P236M, S223L, N239F, H146Y, P236I, G221V, D164C, K120G, D164M, S235I, R248V, A124V, S235L, S223V, S147L, S235C, P86M, G208I, D164A, S147I, N239A, K120T, T117I, G110L, R248Y, P182I, A198L, A124L, A215L, A127L, A66L, P86C, G221F, R248T, T171F, P182V, S147V, P271V, T171V, G110V, P271A, E191A, A149L, K120Y, G114I, K120S, S235F, A201I, G131V, A201V, R248N, A66V, A202I, G221C, G114V, A229L, H146T, A124F, A127F, T117V, S223C, A215F, A127I, P182C, A215V, G162L, G162I, G208F, A201L, A161F, N157A, A198V, E191Y, A161V, S223F, G221M, R248W, G131C, A202V, N157T, S147F, N157Y, G114A, T171C, H146W, S78T, A149I, G250L, N239T, A149V, G208C, K120P, G250V, S235G, S223M, D164V, N239G, T171M, E191G, S78A, D164Y, P271I, G110F, G110C, D164W, P236Y, A124C, A66F, S147M, G75L, E305N, S147C, G221I, A127M, P182L, G221A, G110M, A66C, E305Q, P271F, A215M, P236W, K120W, H146P, A161C, A229I, S78G, G114M, P86A, E305W, V154L, G185V, G75I, S223Y, G75V, R248Q, T277V, E191S, A229F, T277G, G131I, N239S, P271C, V154I, A66M, D164G, G208A, P236T, R248D, D164T, A127C, A215I, A161M, P86W, A201F, C53L, T117F, G131A, T117C, A318L, F150L, G208M, P271M, A149C, G208V, G114C, G162F, S223W, A198I, N157G, A202L, P236G, G185I, A198F, A149M, P86Y, E191W, N157W, I263L, S235T, E305P, E305R, A201C, A201M, F150I, G96I, G114F, G221Y, A199L, D164S, A124M, A179I, A202F, H146S, A231L, C53I, I263V, G162M, K120Q, N239Y, G96L, G75C, N157S, T277C, T117A, A199V, G162C, P271Y, G250C, A127Y, A66I, T117L, G185C, A229C, R248P, A144I, T117M, P86T, A260L, G185A, E191Q, G131L, T277I, G250I, G131M, T277A, A127V, F150V, A318I, S78W, S147Y, A198M, P86G, A215C, A70I, S235M, A179V, A202M, A144V, A202C, G208W, T171Y, S147W, G208Y, G250F, A195L, K120H, A127W, A66Y, S223G, K120N, S78Y, E191N, A198C, P271G, V154F, A70V, H146N, A229M, A134L, P86S, S78Q, A199I, G75M, A68C, E191T, A89L, G96A, D164P, C53V, S78P, G185L, A149G, A149F, P182A;

DsA2: A161L, A161I, A126I, A126V, A126L, S175G, G190H, A161T, S183T, R336I, A126F, A161F, A329L, A161V, S283L, A205L, G109A, A329I, G265F, A161W, A232I, S175W, R336L, A300I, K349I, A161M, A300L, G109L, G109I, A246L, S183M, A223L, E235V, G252L, A329M, A126W, S183L, A259L, A329V, A329F, S183I, A242L, G109F, R336V, K117I, R336C, K117C, K349V, R336A, R336F, K117L, R336M, E235I, R310A, K349L, K117V, R310V, K349C, N201I, R310I, R310C, K349F, K349M, K117M, R292C, N201V, R336G,

R292L, K117F, E235C, P130L, E235A, D208L, P280L, E235L, R292M, R336T, P280V, R292I, N201L, E235M, P130I, K117A, K349A, P130V, R292G, R310F, R336S, R336Y, N201C, K117G, R310L, R310M, R310G, R336W, D208V, R292F, P130F, K349Y, K117T, R310T, P280C, R292S, N201F, R310S, T215L, N201M, S279C, R292A, S279L, P280F, D208C, S175V, A126M, P280A, S279A, P130C, S279V, E235F, P186C, P130M, K349T, A126C, K349G, N320V, K117S, N320I, S283V, A168I, N320L, S175I, E235Y, P186V, P280I, P186A, P280M, G265L, D208M, P186L, K117Y, S283I, A205I, D208F, A168L, T215I, R292V, A133L, R336P, R310Y, A168V, S279F, S183V, A164I, S279I, S175L, D208A, K349S, E235T, S175C, A122I, D208I, A126Y, A123L, K117P, N320C, R292T, S283C, E235W, G252I, T215V, R292Y, R336Q, S175A, A123I, E235G, A205V, A171V, A133V, A245I, S183C, P226V, R310P, G181I, P226I, A168C, A246I, A171L, N201A, S175M, G158I, A164L, T215C, A164C, P280W, A133C, G119I, T215F, A245V, N320M, A122V, A123V, G206L, N320A, G265V, A122L, A193L, S191V, R310W, G252F, G181V, E235S, R292N, P130W, G119V, G265C, S279M, A259V, A259F, A168F, A168M, A246V, P226C, R292W, G158V, P130Y, G206V, P186G, C97L, N201Y, A171C, G265M, G140L, K117N, G140I, D208G, A193V, G181F, K349W, S279G, A245L, A205F, G158A, A193I, K117W, A122C, R310D, G294V, P186T, S175F, S191C, N201T, K349Q, R310N, A242V, T215M, D208Y, T321C, G252C, I276L, A259M, A171F, N201G, G119F, D208T, P186M, G229V, G294L, S191I, P186S, G119C, G229I, P130A, A205C, A171M, T321V, A193C, F268L, A133M, A123F, G357A, G109V, K117Q, N320G, R310Q, T321G, S283M, P186Y, G229A, R336D, N201S, S183F, F194L, F268V, A245F, G265A, G252A, R336H, A259I, A133I, A123C, P130T, G113L, D208S, P280T, F268I, G181C, P280Y, R336E, P280G, G158C, N320Y, G140V, K349P, R292D, D208W, N320F, G265I, R336N, A164M, G206M, F268C, G158M, R292P, S191L, G158F, G252M, A245C, G229C, E235Q, G252V, A205M, G206F, R292Q, G181M, A126G, A243L, K349N, S283A, A246M, S279T, P186I, A246F, A246C, A223I, C97I, A164V, A245M, A171I, G357I, A126T, S283F, A123M, F194I, K117D, P226L, P130S, G140F, I276F, F194V, A243V, P130G, G181L, G229F, A259C, G113I, K117H, N320S, G119M, A239L, G206C, A114I, E235N, K349D, A242I, A161C, G294C, G119L, A126S, T321L, A193M, A223V, A122M, G113C, A242C, N201W, R292H, A275L, A242M, G357V, P186F, G294I, D208P, A259W, A243I, R310E, G140C, A242F, G265W, S183A, G109C, G113F, S191F, G265Y, S94D, E95K, A343K, A350K, F176D, N196D, H147D, H146D, H147E, H146E, T91E, R250E, T91D, R251E, R148D, H254E, A170K, R250K, R251K, H254D, A170R, H146K, H147K, K346E, T90D, R250D, T90E, A138K, R251D, H262K, A169K, H146R, I102E, T90K, A271K, K346R, H306E, D124E, K326E, A169R, D124R.

8. The polypeptide of any one of claims 1-7, wherein the polypeptide further comprises at least one additional amino acid sequence comprising or consisting of at least one additional *P. acnes* antigen or *P. acnes* epitope which is not a DsA1 or DsA2 antigen or epitope, preferably at least one additional amino acid sequence containing at least the putative iron-transport protein (PITP) polypeptide of *P. acnes* or a fragment or derivative thereof, wherein the PITP polypeptide comprises from N- to C-terminus an extended neocarzinostatin family domain ("ENFD"), a first swapping region ("SR1"), a heme-binding domain ("HbD"), a second swapping region ("SR2") including the C-terminal LPXT(G) motif, and a hydrophobic C-terminal region ("hLAR"), wherein the ~~fragment and/or the derivative comprises or consists at least of a PITP epitope, wherein the~~ PITP domains are defined as follows: ENFD from A32 to R164; SR1 from E165 to K237, HbD from V238 to L396, SR2 (including C-terminal LPXT(G) motif (i.e. including LPXT, but not the G)) from S397 to T430, and hLAR from G431 to I467 in the sequence of Q6A9N1 ~~or any other functional PITP sequence comprising all these domains, especially the PITP sequences of Fig.12 comprising all these domains.~~ of the UniProt database (SEQ ID NO: 66).

~~8. Vaccine according to claim 7, wherein the fragment and/or derivative is a PITP polypeptide wherein the hLAR is deleted, replaced by a hydrophilic C-terminal region, or partially deleted, wherein the partial deletion results in a loss of hLAR except the N-terminal 12 amino acids of hLAR,~~

preferably except the N-terminal 11 amino acids of hLAR, especially except the N-terminal 10 amino acids of hLAR; or a fragment thereof or derivative thereof comprising at least amino acids corresponding to proline 34 to glutamic acid 73 or proline 94 to threonine 143 of ENFD or valine 238 to asparagine 393 of HbD in the amino acid sequence Q6A9N1 in the UniProt database.

9. 9. Vaccine according to The polypeptide of claim 8, wherein the additional amino acid sequence corresponds to a PITP polypeptide or a fragment or derivative thereof, wherein the fragment or derivative thereof comprises a sequence comprising at least one of ENFD, SR1, HbD, SR2, preferably selected from ENFD and HbD or an epitope containing fragment thereof, more preferred a porphyrin-binding domain thereof, especially wherein the fragment of the PITP polypeptide is selected from the group of the polypeptides consisting of the amino acids A32 to T430, A32 to G426, A32 to Q198, A32 to T143, A32 to K400, A32 to T159, A32 to I177, A32 to Q204, A32 to G234, A32 to R164, A32 to S391, A32 to P179, A32 to R158, A32 to G147, A32 to E73 and P94 to G147; P34 to T430, P34 to G426, P34 to Q198, P34 to T143, P34 to K400, P34 to T159, P34 to I177, P34 to Q204, P34 to G234, P34 to R164, P34 to S391, P34 to P179, P34 to R158, P34 to G147, P34 to E73 and P94 to G147; S240 to S391, A32 to D441, A32 to I440, A32 to E439, A32 to D438, A32 to S437, A32 to S436, A32 to P435, A32 to G434, A32 to E433, A32 to A432, A32 to G431; P34 to D441, P34 to I440, P34 to E439, P34 to D438, P34 to S437, P34 to S436, P34 to P435, P34 to G434, P34 to E433, P34 to A432, P34 to G431; S240 to D441, S240 to I440, S240 to E439, S240 to D438, S240 to S437, S240 to S436, S240 to P435, S240 to G434, S240 to E433, S240 to A432, S240 to G431; A32 to T430, A32 to V429, A32 to P428, A32 to L427, A32 to G426, A32 to R425, A32 to G424, A32 to A423, A32 to G422, A32 to K421, A32 to G420, A32 to S419, A32 to D418, A32 to D417, A32 to G416, A32 to I415, A32 to V414, A32 to K413, A32 to G412, A32 to T411, A32 to V410, A32 to A409, A32 to D408, A32 to V407, A32 to T406, A32 to V405, A32 to N404, A32 to H403, A32 to C402, A32 to V401, A32 to K400, A32 to E399, A32 to A398, A32 to S397, A32 to L396, A32 to T395, A32 to L394, A32 to N393, A32 to T392; P34 to T430, P34 to V429, P34 to P428, P34 to L427, P34 to G426, P34 to R425, P34 to G424, P34 to A423, P34 to G422, P34 to K421, P34 to G420, P34 to S419, P34 to D418, P34 to D417, P34 to G416, P34 to I415, P34 to V414, P34 to K413, P34 to G412, P34 to T411, P34 to V410, P34 to A409, P34 to D408, P34 to V407, P34 to T406, P34 to V405, P34 to N404, P34 to H403, P34 to C402, P34 to V401, P34 to K400, P34 to E399, P34 to A398, P34 to S397, P34 to L396, P34 to T395, P34 to L394, P34 to N393, P34 to T392; G172 to T430, G172 to V401, G172 to K400, G172 to L396, G172 to N393, A199 to T430, A199 to V401, A199 to K400, A199 to L396, A199 to N393, H223 to T430, H223 to V401, H223 to K400, H223 to L396, H223 to N393, T232 to T430, T232 to V401, T232 to K400, T232 to L396, T232 to N393, G234 to T430, G234 to V401, G234 to K400, G234 to L396, G234 to N393, V238 to T430, V238 to V401, V238 to K400, V238 to L396, V238 to N393, S240 to T430, S240 to V429, S240 to P428, S240 to L427, S240 to G426, S240 to R425, S240 to G424, S240 to A423, S240 to G422, S240 to K421, S240 to G420, S240 to S419, S240 to D418, S240 to D417, S240 to G416, S240 to I415, S240 to V414, S240 to K413, S240 to G412, S240 to T411, S240 to V410, S240 to A409, S240 to D408, S240 to V407, S240 to T406, S240 to V405, S240 to N404, S240 to H403, S240 to C402, S240 to V401, S240 to K400, S240 to E399, S240 to A398, S240 to S397, S240 to L396, S240 to T395, S240 to L394, S240 to N393, S240 to T392; 39I-48I, 40P-49T, 41V-50I, 42G-51S, 43R-52G, 44E-53K, 68P-77N, 69A-78S, 70S-79D, 71V-80K, 72P-81F, 73E-82Y, 74F-83G, 75Y-84Y, 76G-85D, 77N-86P, 78S-87S, 79D-88K, 80K-89D, 81F-90T, 82Y-91T, 83G-92E, 84Y-93S, 85D-94P, 86P-95S, 87S-96T, 88K-97I, 89D-98W, 90T-99V, 91T-100Y, 92E-101T, 93S-102P, 94P-103S, 95S-104Q, 96T-105K, 97I-106A, 98W-107I, 99V-108G, 100Y-109S, 101T-110R, 102P-111F, 103S-112A, 104Q-113Q, 105K-114G, 106A-115R, 107I-116P, 108G-117M, 109S-118N, 110R-119N, 111F-120D, 112A-121G, 125I-134Q, 126T-135G, 127M-136K, 128K-137D, 144K-153H, 145A-154S, 146H-155D, 147G-156D, 148V-157T, 149G-158R, 150K-159T, 151T-160P, 152D-161V, 153H-162T, 154S-163Y, 155D-164R, 156D-165E, 157T-166A, 158R-

167T, 159T-168P, 160P-169A, 161V-170P, 162T-171T, 163Y-172G, 164R-173P, 165E-174K, 166A-175T, 167T-176P, 168P-177I, 169A-178A, 170P-179P, 171T-180S, 172G-181K, 173P-182Q, 174K-183P, 175T-184S, 176P-185K, 177I-186Q, 178A-187A, 179P-188A, 180S-189P, 181K-190S, 182Q-191K, 183P-192Q, 184S-193V, 185K-194K, 186Q-195P, 187A-196S, 188A-197K, 189P-198Q, 190S-199A, 191K-200G, 192Q-201P, 193V-202N, 194K-203K, 195P-204Q, 196S-205S, 197K-206T, 198Q-207T, 199A-208P, 200G-209Q, 201P-210Q, 202N-211K, 203K-212T, 204Q-213A, 205S-214E, 206T-215H, 207T-216R, 208P-217S, 209Q-218Q, 210Q-219T, 211K-220P, 212T-221A, 213A-222A, 214E-223H, 215H-224R, 216R-225T, 217S-226M, 218Q-227T, 219T-228K, 220P-229Q, 221A-230V, 222A-231C, 223H-232T, 224R-233I, 225T-234G, 226M-235A, 227T-236S, 228K-237K, 229Q-238V, 230V-239T, 231C-240S, 232T-241G, 233I-242S, 266L-275S, 267S-276A, 268G-277F, 282T-291K, 334S-343N, 353G-362I, 354V-363K, 355S-364G, 356V-365S, 357S-366P, 358G-367V, 359N-368K, 377F-386P, 378A-387M, 379G-388N, 380F-389P, 396L-405V, 397S-406T, 398A-407V, 399E-408D, 400K-409A, 401V-410V, 402C-411T, 403H-412G, 404N-413K, 405V-414V, 406T-415I, 407V-416G, 408D-417D, 409A-418D, 410V-419S, 411T-420G, 412G-421K, 413K-422G, 414V-423A, 415I-424G, 416G-425R, 417D-426G, 418D-427L, 419S-428P, 420G-429V, 421K-430T, 422G-431G, 423A-432A, 424G-433E, 425R-434G, 426G-435P, 427L-436S, 428P-437S, 429V-438D, 430T-439E, 431G-440I, 432A-441D, 433E-442L, 434G-443G, 435P-444I, 436S-445V, and 437S-446G; I39-K53, P68-G121, I125-D137, K144-S242, L266-F277, T282-K291, S334-N343, G353-K368, F377-P389, and L396-G446, especially a fragment or derivative comprising or consisting of the fragments selected from the group consisting of the PITP fragments A32 to R164, A32 to Q198, A32 to T143, A32 to V148, A32 to T171, P34 to R164, A32 to T159, A32 to I177, A32 to Q204, A32 to G234, A32 to K400, A32 to S391, V238 to K400, A199 to T430, V238 to T395, G234 to K400, H223 to K400, T232 to V401, V238 to T392, V238 to N393, V238 to L394, V238 to T395, V238 to L396, T232 to T430, G172 to K400, and G172 to G234, and fragments thereof comprising at least of a PITP epitope, according to the amino acid numbering in the amino acid sequence Q6A9N1 of the UniProt database (SEQ ID NO: 66).

The polypeptide of claim 7 or 8, wherein the PITP fragment and/or derivative is a PITP polypeptide wherein the hLAR is deleted.

10. 10. Vaccine according to any one of claims 7 to or 9, wherein the PITP derivative comprises

(i) an amino acid exchange at positions Y63, H146, H153, F74, L141, F81, P72, K144, T143, Y75, W98, D156, and R158. C231 (e.g. C231S) and/or C402 (e.g. C402S); and/or

11. Vaccine according to any one of claims 7 to 10, wherein the PITP derivative comprises an amino acid exchange exchange at positions C231 and C402.

12. Vaccine comprising at least two antigenic polypeptides with epitopes of *P. acnes* which are surface exposed, wherein preferably at least one epitope is an epitope of a dermatan sulfate-binding adhesin 1 of *P. acnes* (DsA1 polypeptide) which is surface exposed or an epitope of a dermatan sulfate-binding adhesin 2 of *P. acnes* (DsA1 polypeptide) which is surface exposed or an epitope of a putative iron-transport protein of *P. acnes* (PITP polypeptide) which is surface exposed,

wherein DsA1 or DsA2 comprises from N- to C-terminus an N-terminal swapping region ("NSR"), a first conserved sub-domain ("CSD1"), a first swapping region ("SR1"), a second conserved sub-

domain (“CSD2”), a second swapping region (“SR2”), a third conserved sub-domain (“CSD3”), a Pro-Thr repeat containing region (“PT repeat region”), and a C-terminal region (“CTR”), and

wherein the PITP polypeptide comprises from N- to C-terminus an extended neocarzinostatin family domain (“ENFD”), a first swapping region (“SR1”), a heme-binding domain (“HbD”), a second swapping region (“SR2”) including the C-terminal LPXT(G) motif, and a hydrophobic C-terminal region (“hLAR”),

wherein the DsA1 domains are defined as follows: NSR: from S29 to I48, CSD1 from I49 to L130, SR1 from G131 to S147, CSD2 from A148 to L267, SR2 from A268 to T277, CSD3 from A278 to K323, the PT repeat region from P324 to T361, and CTR from S362 to F405 in the sequence of Q6A5X9 or any other functional DsA1 sequence comprising all these domains, especially the DsA1 sequences of Fig.12 comprising all these domains;

and/or wherein the DsA2 domains are defined as follows: NSR: from A72 to K92, CSD1 from I93 to L174, SR1 from S175 to S191, CSD2 from A192 to L311, SR2 from A312 to T321, CSD3 from A322 to E366, the PT repeat region from P367 to T420, and CTR from H421 to A463 in the sequence of Q6A5P9 or any other functional DsA2 sequence comprising all these domains, especially the DsA2 sequences of Fig.12 comprising all these domains;

and/or wherein the PITP domains are defined as follows: ENFD from A32 to R164; SR1 from E165 to K237, HbD from V238 to L396, SR2 (including C-terminal LPXT(G) motif (i.e. including LPXT, but not the G)) from S397 to T430, and hLAR from G431 to I467 in the sequence of Q6A9N1 or any other functional PITP sequence comprising all these domains, especially the PITP sequences of Fig.12 comprising all these domains.

13. Vaccine comprising

- at least one antigenic polypeptide with an epitope of a DsA1 polypeptide which is surface exposed or an epitope of a dermatan sulfate-binding adhesin 2 of *P. acnes* (DsA2 polypeptide) which is surface exposed,

wherein DsA 1 or DsA2 comprises from N- to C-terminus an N-terminal swapping region (“NSR”), a first conserved sub-domain (“CSD1”), a first swapping region (“SR1”), a second conserved sub-domain (“CSD2”), a second swapping region (“SR2”), a third conserved sub-domain (“CSD3”), and, optionally, a Pro-Thr repeat containing region (“PT repeat region”), and a C-terminal region (“CTR”); and

- at least one antigenic polypeptide with an epitope of a PITP polypeptide which is surface exposed,

wherein the DsA1 domains are defined as follows: NSR: from S29 to I48, CSD1 from I49 to L130, SR1 from G131 to S147, CSD2 from A148 to L267, SR2 from A268 to T277, CSD3 from A278 to K323, the PT repeat region from P324 to T361, and CTR from S362 to F405 in the sequence of Q6A5X9 or any other functional DsA1 sequence comprising all these domains, especially the DsA1 sequences of Fig.12 comprising all these domains;

and/or wherein the DsA2 domains are defined as follows: NSR: from A72 to K92, CSD1 from I93 to L174, SR1 from S175 to S191, CSD2 from A192 to L311, SR2 from A312 to T321, CSD3 from A322 to E366, the PT repeat region from P367 to T420, and CTR from H421 to A463 in the sequence of

Q6A5P9 or any other functional DsA2 sequence comprising all these domains, especially the DsA2 sequences of Fig.12 comprising all these domains.

14. Vaccine according to any one of claims 5 to 13 comprising a polypeptide

(a) comprising at least an epitope-containing fragment or derivative of CSD1 of DsA1 and at least an epitope-containing fragment or derivative of CSD2 of DsA2; and/or

(b) comprising at least a polypeptide stretch comprising a CSD1 fragment or derivative of CSD1 of DsA1 of at least 30 amino acid residues, preferably at least 40 amino acid residues, and at least a polypeptide stretch comprising a CSD2 fragment or derivative of CSD2 of DsA1 of at least 30 amino acid residues, preferably at least 40 amino acid residues;

(c) comprising at least

- a contiguous polypeptide sequence of phenylalanine 150 (F150) to leucine 184 (L184),
- a contiguous polypeptide sequence of phenylalanine 150 (F150) to leucine 267 (L267), or
- a contiguous polypeptide sequence of histidine 218 (H218) to leucine 267 (L267) of DsA1, and
- a contiguous polypeptide sequence of phenylalanine 194 (F194) to leucine 228 (L228),
- a contiguous polypeptide sequence of phenylalanine 194 (F194) to leucine 311 (L311), or
- a contiguous polypeptide sequence of histidine 262 (H262) to leucine 311 (L311) of DsA2.

15. Vaccine according to any one of claims 5 to 14, wherein the polypeptide comprises an amino acid exchange at one or more of C53, C319 and C321 of DsA1, and C97 and C363 of DsA2, if present in the polypeptide, preferably one or more of amino acid exchanges C53S, C319S and C321P of DsA1 and C97S and C363S of DsA2.

16. Vaccine according to any one of claims 5 to 15, wherein in the fragment or derivative at least 5 PT repeats, preferably at least 10 PT repeats, especially at least 15 PT repeats, are deleted compared to a naturally occurring wild type DsA1/DsA2 polypeptide ("native DsA1/DsA2"), and wherein preferably at least one, more preferred at least two, more preferred at least three, even more preferred at least four, especially five, PT repeat(s) is/are present.

17. Vaccine according to any one of claims 5 to 16, wherein the polypeptide further comprises a PITP polypeptide or a fragment or derivative of PITP comprising a polypeptide stretch of at least 30 amino acid residues comprising at least an epitope of PITP, preferably wherein the PITP polypeptide or a fragment or derivative of PITP comprises at least

- a contiguous polypeptide sequence of proline 34 to glutamic acid 73 of ENFD or a PITP derivative thereof,

- a contiguous polypeptide sequence of proline 94 to threonine 143 of ENFD or a PITP derivative thereof, or

- a contiguous polypeptide sequence of valine 238 to asparagine 393 of HbD or a PITP derivative thereof.

18. Vaccine according to claim 17, wherein the PITP derivative comprises an amino acid exchange at positions C231 and C402.

19. Vaccine comprising

- at least one synthetic antigenic polypeptide with an epitope of a DsA1(ii) one or more, preferably one, two or three, especially one, of the following amino acid exchanges: T392F, F352L, T392I, M303F, A276Y, S365I, T392L, M303W, A276L, T392W, K363T, A361V, F286Y, A361I, K363F, M303Y, T392V, A361L, S365V, A270V, A276M, S365L, K363V, M312L, T252L, M387L, Y297F, A276F, G353T, A276W, K363S, T252R, L314I, T252I, A361F, L295I, L255I, A276I, K363L, S318W, V354L, K363I, A361T, S318I, A361M, G353L, T392Y, S365A, A270I, A361W, T252M, K363A, K363W, L319I, G353D, A276V, G353N, G353F, T252V, G353S, S318V, L255V, G364I, L394V, K363M, S318F, L390I, G353I, S335Y, G364L, S365M, T252Q, S365F, L330A, T252F, S318M, K363Y, G353V, S365G, S365W, K363G, T392M, V354F, A276T, G364W, K363C, P317I, S335C, P317L, P317F, G269C, S335A, P317V, G268C, S334V, S335V, G269V, S334C, A361C, G268I, G269F, G268L, S334I, G268V, G269L, S335G, S334A, G268F, S335T, P317C, P317M, S335L, A361Y, G269I, S335I, G268Y, K363P, G268W, S335M, K363H, F286I, G268M, G269M, G269W, G268A, S334G, S334L, G268P, G268T, G293F, F286L, T252C, S335N, T392C, K363N, S334F, M303I, K363Q, A376L, G364V, W245I, G269S, Y297C, S335Q, G358V, W245L, A376I, S334M, G358L, T252A, S318C, S335H, Y297L, S365C, M312I, G373L, Y297I, G358I, S335F, G268N, M303L, G269T, Y297V, P317A, G268Q, G268H, G293L, S334T, G305C, S318L, S335D, S335P, G364C, W245V, W245F, P317Y, T392A, F286V, S335W, A376V, G358C, K363D, M312F, G269N, S335R, A378I, A378C, P317W, G268K, G268R, G268D, A376C, G373V, M312V, M303V, G353C, S318A, G364F, G241C, G268E, G379I, G269P, F286C, L330F, G284V, W245C, A378V, L330I, G293I, G373C, G379L, S318Y, G358F, L394I, L330V, G373I, F352I, A361G, S335K, G246C, M387F, A378L, G241I, V354C, M387I, G269A, G308C, F352C, A276C, G293C, G269Q, K363R, G379V, F286W, W245M, G246V, A270C, G246L, M303C, G293V, G305A, Y297A, G345I, G241V; N388D, R248K, S336D, T372E, T249E, E316D, D348E, R382E, R382K, K265E, H327K, D338E, K333R, P386E, S336E, K341D, K341E, K341R, E385D, G268K, G268R, G268D, K340R, G268E, K333D, K368R, G353D; H306I+S335R, H306L+S335R, H306I+S335K, H306C+S335R, H306C+S335R, H306I+S335K, H306L+S335K, H306L+S335K, H306L+S335R, H306V+S335R, H306I+S335R, H306V+S335R, H306C+S335K, H306F+S335K, H306V+S335K, H306V+S335K, H306F+S335R, H306F+S335R, H306W+S335R, H306F+S335K, H306M+S335R, H306W+S335K, H306W+S335R, H306M+S335K, H306A+S335R, H306A+S335R, H306W+S335K, H306A+S335K, H306Y+S335R, H306Y+S335R, H306Y+S335K, H306T+S335R, H306Y+S335K, H306T+S335R, H306T+S335K, H306S+S335R, H306T+S335K, H306S+S335K, S334V+S335R, H306S+S335K, S334V+S335K, S334I+S335R, S334C+S335R, H306P+S335R, M312I+S335R, S334I+S335K, S334V+S335R, S334V+S335K, H306P+S335K, S334C+S335R, S334A+S335R, M312F+S335R, M312L+S335R, S334C+S335K, H306R+Y381L, M312L+S335R, S250L+S335R, H306Q+S335R, H306N+S335K, S334C+S335K, S334A+S335K, H306P+S335K, H306Q+S335R, M312V+S335R, M312I+S335K, S334I+S335K, M312I+S335R, M312L+S335K, H306N+S335R, S334L+S335R, S334A+S335K, M312L+S335K, S250I+S335R, H306N+S335R, S250V+S335R,

H306N+S335K, M312F+S335K, S250V+S335R, S250A+S335R, S334M+S335R, M312V+S335R, S250A+S335K, M312F+S335K, S250A+S335K, S250L+S335R, S334G+S335R, S250C+S335R, S250C+S335R, H306Q+S335K, S334G+S335R, Y254F+S335R, S334L+S335R, S250I+S335R, I309C+S335R, S250I+S335K, Y254C+S335R, S250L+S335K, M312V+S335K, S334G+S335K, S250L+H306R, S250V+H306R, H306R+Y381I, M312V+S335K, S250I+H306R, M312C+S335R, Y254C+S335R, S250V+S335K, Y254W+S335R, S334G+S335K, S250L+H306R, S250L+S335K, Y254W+S335R, S250V+S335K, S334L+S335K, I309C+S335R, I309C+S335K, Y254F+S335R, S250A+S335R, S250C+S335K, S250I+H306R, S250A+H306R, S250C+S335K, H306Q+S335K, Y254C+S335K, S334L+S335K, S250A+H306R, I309C+S335K, Y254W+S335K, Y254C+S335K, Y254I+S335R, H306R+Y381C, S250M+S335K, M312C+S335K, M312C+S335K, S250V+H306R, S250M+S335R, Y254V+S335R, Y254I+S335K, S250W+S335R, I259C+S335R, S334M+S335R, Y254A+S335R, Y254V+S335R, S250M+S335K, F251L+S35R, Y254I+H306R, I259C+S335K, Y254I+S335R, I259C+S335K, S250Y+S335K, Y254F+S335K, S250M+S335R, Y254F+H306R, Y254V+S335K, Y254V+H306R, S334T+S335K, S334Y+S335R, Y254A+S335R, S334M+S335K, Y254I+H306R, Y254M+S335K, Y254A+S335K, S334F+S335R, S334M+S335K, F251L+H306R, S334T+S335R, Y254I+S335K, Y254A+S335K, S334T+S335K, S250Y+H306R, Y254A+H306R, Y254M+S335K, F251L+S335K, I259C+S335R, F251L+H306R, Y254M+H306R, S334P+S335R, S334P+S335R, S334P+S335K, S334F+S335R, Y254M+S335R, H306I+S335C, H306L+S335C, H306L+S335C, H306I+S335C, H306V+S335C, H306C+S335C, H306I+S334V, H306V+S335C, H306C+S335C, H306I+S334V, H306L+S335V, H306M+S335C, H306I+S335G, H306I+S335G, H306I+S335A, H306I+S335A, H306F+S335C, H306F+S335C, H306L+S335V, H306I+S335T, H306L+S335A, H306C+S335A, H306I+S335V, H306I+S335V, H306L+S334V, H306L+S335A, H306C+S335V, H306L+S334C, H306I+S335I, H306I+S334A, H306L+S334C, H306L+S334V, H306F+S334V, H306C+S335A, H306F+S335V, H306C+S334V, H306C+S334V, H306I+S335L, H306C+S335V, H306L+S334I, H306M+S335C, H306I+S334C, H306I+S335I, H306W+S335C, H306V+S335A, H306I+S334C, H306I+S334I, H306L+S335I, H306V+S335A, H306C+S334C, H306L+S335G, H306C+S334C, H306L+S335T, H306I+S334I, H306V+S334V, H306I+S335L, H306M+S335V, H306V+S335V, H306V+S335V, H306I+S335M, H306L+S335T, H306V+S335I, H306C+S335G, H306L+S335L, H306C+S334I, H306L+S335Y, H306L+S335I, H306V+S334V, H306C+S335G, H306I+S334A, H306L+S334A, H306C+S335I, H306F+S335V, H306I+S335T, H306L+S335Y, H306C+S334I, H306L+S334I, H306V+S335G, H306V+S335G, H306A+S335C, H306A+S335C, H306M+S335A, H306C+S334A, H306V+S335I, H306L+S335G, H306L+S334A, H306C+S334A, H306I+S335Y, H306I+S335Y, H306W+S335C, H306F+S335A, H306F+S335A, H306F+S335I, H306I+S335N, H306L+S335L, H306I+S335M, H306I+S335N, H306V+S334I, H306V+S334C, H306V+S335L, H306C+S335L, H306C+S335L, H306I+A376L, H306F+S335T, H306L+S335M, H306F+S334V, S334V+S335C, S335C+Y381L, S335C+A376I, S334I+S335C, S334V+S335C, M312I+S335C, M312I+S335C, S335C+A376L, S334I+S335C, S335C+A376L, S335C+A378C, S335C+A376C, S335C+A376V, S334A+S335C, S335C+A378C, S334A+S335C, S335C+A376I, S334V+S335A, S335A+A376L, S335C+A376C, S335C+A376V, S335C+A378L, S334V+S335A, S335A+A376I, S334V+A376L, S334I+S335V, S335C+A378I, M312F+S335C, M312F+S335C, S334I+S335A, S335C+A378V, S335V+A376L, S334V+S335L, S335C+A378I, S334C+S335V, S334V+A376I, S334V+A376I, S335V+A376I, M312I+S334V, S334V+S335I, S335C+Y381I, M312V+S335C, S335C+A378L, S335A+Y381L, S334C+A376C, S334V+S335I, S335C+Y381V, M312L+S335C, S335C+A378V, S335V+A376L, S334I+S335V, S335C+Y381C, S335V+A376I, S334C+A376L, S334C+Y381L, M312V+S335C, S334V+S335L, S334C+A376I, S334C+A376C, S334V+Y381L, M312L+S335C, S335V+A376V, S334I+A376I, S335V+A376V, S335V+Y381L, Y254F+S335C, L310F+S335C, S335I+A376I, S334V+A376V, M312I+S335V, S334C+S335A, S334I+A376L, M312F+S335V, S335C+Y381A, L310F+S335C, S334G+S335C, S334G+S335C, S334V+A376V, S335C+A376M, S335C+A376M, S334A+S335I,

S334V+A376L, M312C+S335C, S334C+S335A, S335A+A376V, S334A+S335V, S334A+S335V, Y254F+S335C, S335A+A376L, S335A+Y381I, S335A+A376I, S334L+S335C, S335A+A376V, M312C+S335C, D152F, D152L, D152I, D152V, D152M, D152W, D152Y, D152S, D152A, D152T, D152G, D152N, D152Q, D152P, D152H, D152K, D152R, D152C, D155Q, D155L, D155F, D155I, D155M, D155W, D155V, D155Y, D155A, D155N, D155T, D155S, D155P, D155G, D155H, D155R, D155K, D155C, D156L, D156F, D156I, D156W, D156V, D156A, D156Y, D156M, D156G, D156S, D156T, D156Q, D156N, D156P, D156H, D156K, D156R, D156C, H146R, H146K, H153R, H153K, Y63A, H146A, H153A, F74A, L141A, F81A, P72A, K144A, T143A, Y75A, W98A, D156A, R158A, S250W, S250F, S250D, S250E, S250K, S250R, F251A, Y254A, I259W, I259F, I259D, I259E, I259R, I259K, H306A, I309W, I309F, I309E, I309D, I309R, I309K, L310W, L310F, L310D, L310E, L310R, L310K, M312W, M312F, M312D, M312E, M312R, M312K, S334W, S334F, S334D, S334E, S334R, S334K, S335W, S335F, S335D, S335E, S335K, S335R, M337W, M337F, M337D, M337E, M337K, M337R, A376W, A376F, A376E, A376D, A376R, A376K, F377, A378W, A378F, A378D, A378E, A378K, A378R, F380A, Y381A, D348I, D348L, D348M, D348F, D348V, D348Y, D348A, D348W, D348T, D348G, D348P, D348H, D348S, D348R, D348K, D348E, D348C, H306R, H306D, H306E, H306K, H307D, H307R, H307E, H307K, H327R, H327K, H327E, H327D, H302E, H302K, H302R, H302D, H215K, H215R, H215E, H215D, H223K, H223R, H223E, H223D, H403K, H403R, H403E, H403D.

11. A nucleic acid encoding the polypeptide of any one of claims 1-10, optionally wherein the nucleic acid is DNA or RNA (e.g., mRNA).

12. A pharmaceutical composition, e.g. a vaccine, comprising a polypeptide of any one of claims 1-10.

13. The pharmaceutical composition of claim 12, wherein the polypeptide comprises any one of SEQ ID NO: 44-50 (e.g., SEQ ID NO: 49), optionally wherein the polypeptide lacks an N-terminal methionine residue.

14. The pharmaceutical composition of claim 12 or 13, wherein the pharmaceutical composition further comprises another *P. acnes* antigen or epitope or an epitope-containing fragment of another *P. acnes* polypeptide, preferably wherein the pharmaceutical composition comprises a PITP polypeptide, or fragment or derivative thereof, e.g. wherein the PITP polypeptide comprises any one of SEQ ID NO: 14-20 (e.g., SEQ ID NO: 20), optionally wherein the polypeptide lacks an N-terminal methionine residue.

15. The pharmaceutical composition of any one of claims 12-14, wherein the composition comprises:
    (i) a polypeptide comprising SEQ ID NO: 20, optionally wherein the polypeptide lacks an N-terminal methionine residue; and
    (ii) a polypeptide comprising SEQ ID NO: 49, optionally wherein the polypeptide lacks an N-terminal methionine residue.

16. The pharmaceutical composition of any one of claims 12-15, wherein
    (i) the polypeptide comprising at least a DsA1, or a fragment or derivative thereof, and at least a DsA2, or a fragment or derivative thereof; and/or

    (ii) the another *P. acnes* antigen or epitope or an epitope-containing fragment of another *P. acnes* polypeptide (e.g., PITP)

    is provided as DNA or RNA encoding the polypeptide, preferably as mRNA.

17. A pharmaceutical composition, e.g. a vaccine, comprising a nucleic acid of claim 11.

18. The pharmaceutical composition of claim 17, wherein the nucleic acid encodes a polypeptide comprising any one of SEQ ID NO: 44-50 (e.g. SEQ ID NO: 49), optionally wherein the polypeptide lacks an N-terminal methionine residue.

19. The pharmaceutical composition of claim 17 or 18, wherein the pharmaceutical composition further comprises another nucleic acid encoding a *P. acnes* antigen or epitope or an epitope-containing fragment of another *P. acnes* polypeptide, preferably a PITP polypeptide, or fragment or derivative thereof, e.g. wherein the PITP polypeptide comprises any one of SEQ ID NO: 14-20 (e.g. SEQ ID NO: 20), optionally wherein the polypeptide lacks an N-terminal methionine residue.

20. The pharmaceutical composition of any one of claims 17-19, wherein the composition comprises:
    (i) a nucleic acid encoding a polypeptide comprising SEQ ID NO: 20, optionally wherein the polypeptide lacks an N-terminal methionine residue; and
    (ii) a nucleic acid encoding a polypeptide comprising SEQ ID NO: 49, optionally wherein the polypeptide lacks an N-terminal methionine residue.

21. The pharmaceutical composition of any one of claims 12-20, wherein the pharmaceutical composition:
    (a) further comprises a pharmaceutically acceptable excipient;
    (b) is formulated with an adjuvant, preferably with an adjuvant selected from the group consisting of mineral salts, preferably alum (potassium aluminum sulfate), aluminum hydroxide, aluminum phosphate, aluminum oxohydroxide, aluminum hydroxyphosphate, calcium phosphate, cerium nitrate, zinc sulfate, colloidal iron hydroxide, and/or calcium chloride; oil-in-water emulsions, liposomes, TLR agonists, Monophosphoryl Lipid A, saponins, phospholipids, emulsion-based adjuvants, aluminium hydroxide gel, solid phase adsorbents, nanospheres and encapsulating materials such as liposomes; high molecular weight adjuvants, preferably toxins, toxoids or any mutant cross-reactive material of the toxin from tetanus, diphtheria, pertussis, Pseudomonas species, *E. coli*, Staphylococcus species, and Streptococcus species. Such toxins or toxoids may be tetanus toxoid, pertussis toxoid, cholera toxoid, E. coli LT, E. coli ST, and exotoxin A from *Pseudomonas aeruginosa*; bacterial outer membrane proteins such as outer membrane protein complex c (OMPC), porins, transferrin binding proteins, pneumolysin, pneumococcal surface protein A (PspA), pneumococcal adhesin protein (PsaA), C. difficile enterotoxin (toxin A) and cytotoxin (toxin B) or Haemophilus influenzae protein D, other pharmaceutically acceptable polypeptide carriers, such as ovalbumin, keyhole limpet hemocyanin (KLH), bovine serum albumin (BSA) or purified protein derivative of tuberculin (PPD); cationic peptides, CpG oligonucleotide, squalene-based adjuvants, preferably MF59; cytokines, such as IL-1 and IL-2; or combinations thereof;
    (c) is formulated as virus-like particles or nanoparticles;
    (d) is formulated for intradermal, subcutaneous (s.c.), parenteral, intramuscular (i.m.), mucosal, transcutaneous or topical administration; and/or
    (e) comprises 0.1 µg to 5 mg, preferably 0.5 to 1000 µg, more preferably 1 to 500 µg, even more preferably 5 to 300 µg, especially 10 to 200µg, of the polypeptide of any one of claims 1-10 per dose.

22. The polypeptide ~~which is surface exposed or an epitope of a DsA2~~of any one of claims 1-10, the nucleic acid of claim 11, or the pharmaceutical composition of any one of claims 12-21 for use as a medicament.

23. Use of the polypeptide ~~which is surface exposed; and~~of any one of claims 1-10, the nucleic acid of claim 11, or the pharmaceutical composition of any one of claims 12-21 for the

preparation of a medicament for treating or preventing a *P. acnes*-associated infection in a patient, preferably a human patient, optionally wherein the *P. acnes*-associated infection is at least one synthetic antigenic polypeptide with an epitope of a PITP polypeptide of P. acnes which is surface exposed.

20. A polypeptide comprising at least one polypeptide stretch of Dermatan sulfate-binding adhesin 1 of *P. acnes* (DsA1) and at least one polypeptide stretch of Dermatan sulfate-binding adhesin 2 of *P. acnes* (DsA2), said DsA1 and DsA2 comprising from N- to C-terminus an N-terminal region, a first conserved sub-domain ("CSD1"), a first swapping region ("SR1"), a second conserved sub-domain ("CSD2"), a second swapping region ("SR2"), a third conserved sub-domain ("CSD3"); and, optionally a Pro-Leu repeat containing region ("PT repeat region"), and a C-terminal region;

wherein the polypeptide comprises at least an epitope of CSD1, CSD2 or CSD3 of DsA1 and at least an epitope CSD1, CSD2 or CSD3 of DsA2, preferably wherein the polypeptide comprises at least CSD1, CSD2 or CSD3 of DsA1 and CSD1, CSD2 or CSD3 of DsA2,

wherein the DsA1 domains are defined as follows: NSR: from S29 to I48, CSD1 from I49 to L130, SR1 from G131 to S147, CSD2 from A148 to L267, SR2 from A268 to T277, CSD3 from A278 to K323, the PT repeat region from P324 to T361, and CTR from S362 to F405 in the sequence of Q6A5X9 or any other functional DsA1 sequence comprising all these domains, especially the DsA1 sequences of Fig.12 comprising all these domains;

and/or wherein the DsA2 domains are defined as follows: NSR: from A72 to K92, CSD1 from I93 to L174, SR1 from S175 to S191, CSD2 from A192 to L311, SR2 from A312 to T321, CSD3 from A322 to E366, the PT repeat region from P367 to T420, and CTR from H421 to A463 in the sequence of Q6A5P9 or any other functional DsA2 sequence comprising all these domains, especially the DsA2 sequences of Fig.12 comprising all these domains.

21. A polypeptide comprising at least one polypeptide stretch of Dermatan sulfate-binding adhesin 1 of *P. acnes* (DsA1) and at least one polypeptide stretch of Dermatan sulfate-binding adhesin 2 of *P. acnes* (DsA2), said DsA1 and DsA2 comprising from N- to C-terminus an N-terminal region, a first conserved sub-domain ("CSD1"), a first swapping region ("SR1"), a second conserved sub-domain ("CSD2"), a second swapping region ("SR2"), a third conserved sub-domain ("CSD3"); and, optionally, a Pro-Leu repeat containing region ("PT repeat region"), and a C-terminal region;

wherein the polypeptide stretch of DsA1 and DsA2 has independently a length of at least 20 amino acid residues,

wherein the DsA1 domains are defined as follows: NSR: from S29 to I48, CSD1 from I49 to L130, SR1 from G131 to S147, CSD2 from A148 to L267, SR2 from A268 to T277, CSD3 from A278 to K323, the PT repeat region from P324 to T361, and CTR from S362 to F405 in the sequence of Q6A5X9 or any other functional DsA1 sequence comprising all these domains, especially the DsA1 sequences of Fig.12 comprising all these domains;

and/or wherein the DsA2 domains are defined as follows: NSR: from A72 to K92, CSD1 from I93 to L174, SR1 from S175 to S191, CSD2 from A192 to L311, SR2 from A312 to T321, CSD3 from A322 to E366, the PT repeat region from P367 to T420, and CTR from H421 to A463 in the sequence of

Q6A5P9 or any other functional DsA2 sequence comprising all these domains, especially the DsA2 sequences of Fig.12 comprising all these domains.

22. Vaccine for use in the treatment or prevention of P. acnes-associated infections, comprising a polypeptide comprising an epitope of DsA1 and/or DsA2 and/or PITP, wherein the epitope is selected from the group consisting of R32-I41, Q38-K51, R32-K51, T43-K51, Q38-K51, R87-K90+T43-K51, R87-K90+T117-I132 and R87-K90+S234-G250, R87-K90+L246-A260, R87-K90+A256-E270, R87-K90+R266-T277, T117-I132, T117-A127, V128-I132, A144-N157, H146-A160, A148-N157, A156-A170, K166-L180, A176-T190, P186-A198, N181-E191, I216-F224, I216-D225, A226-A240, S234-G250, I251-I263, I251-L267, I264-P271, P236-G250, L246-A260, A256-E270, S234-G250, I251-L267, A268-L280, R266-T277, T285-R286+I216-F224, T285-R286+I264-P271, T285-R286+V289-K296, T285-R286+V289-K296, T285-R286+A144-N157, A310-D313+T285-R286, T285-D290, T285-D290+V291-T300, T285-D290+A301-E307, V291-T300, A301-E307, T285-T300, A301-E307, R286-D290+ V291-T300, R286-D290+A301-E307, V289-K296, A310-D313+I216-F224, A310-D313+I264-P271, A310-D313+T285-R286, A310-D313+R286-D290, A310-D313+V289-K296, A310-D313+V289-K296, A310-D313+T285-T300, A310-D313+A144-N157, A310-D313+T285-R286, A310-D313+T285-D290, A310-D313+T293-E307, T285-D290, V291-T300, T293-E307, A301-E307 of DsA1; L152-Q166, G190-P230, I199- D208, A218-I237, P230-Q244, I231-A270, H254-A270, A271-S279, A271-R310, L311-T321, L311-K323, V333-Q347, A218-P230, I231-I237, H254-H262, Q256-H262, E261-D269, D269-S279, K313-K323, of DsA2; D79-T90, E73-D85, R43-I50, P68-Y75, P86-E92, I39-G45, Y84-D89, F81-D89, D79-D89, T37-E44, E73-W98, E73-F81, D79-T90, P72-F81, A129-F138, D120-Q134, F111-D120, F132-G147, D152-E165, R115-F123, D120-K128, P131-F138, N181-E191, T143-T159, P116-T124, P131-D137, P131-D137, T175-C231, Q198-K203, P179-K185, G200-Q210, K174-A188, K174-K185, P201-Q209, P183-P201, P183-K191, K185-P195, R164-S180, E165-S180, K185-S190, V193-N202, V193-G200, K203-P208, R216-T225, R216-R224, P173-K191, K197-K203, P168-T175, K185-K203, R164-K174, T175-V193, S250-N261, D287-S300, K340-V347, D338-F352, D338-D348, S285-P288+G305-L314, S285-P288+H306-L314, S285-P288+T342-T351, S285-P288+D338-D348, D287-S300, T342-T351, D338-D348, H306-L314, G305-L314, G364-K375, R382-E399, V367-G373, A383-L390, T342-T351, M387-T395, E385-T392, V401-V410, N404-A409, G416-L427, L396-V410, T406-I415, D417-G424, V407-D418, V407-V414, K421-V429, S419-T430, D408-I415, T406-V414, of PITP, preferably wherein the epitope comprises at least one additional amino acid residue at the N- or C-terminus of the DsA1, DsA2, or PITP sequence, especially wherein the epitope comprises at least two additional amino acid residue at the N- or C-terminus of the DsA1, DsA2, or PITP sequence; wherein the polypeptide is preferably covalently linked to a carrier molecule or embedded in a scaffold molecule, especially a carrier polypeptide,

wherein the DsA1 domains are defined as follows: NSR: from S29 to I48, CSD1 from I49 to L130, SR1 from G131 to S147, CSD2 from A148 to L267, SR2 from A268 to T277, CSD3 from A278 to K323, the PT repeat region from P324 to T361, and CTR from S362 to F405 in the sequence of Q6A5X9 or any other functional DsA1 sequence comprising all these domains, especially the DsA1 sequences of Fig.12 comprising all these domains;

and/or wherein the DsA2 domains are defined as follows: NSR: from A72 to K92, CSD1 from I93 to L174, SR1 from S175 to S191, CSD2 from A192 to L311, SR2 from A312 to T321, CSD3 from A322 to E366, the PT repeat region from P367 to T420, and CTR from H421 to A463 in the sequence of Q6A5P9 or any other functional DsA2 sequence comprising all these domains, especially the DsA2 sequences of Fig.12 comprising all these domains;

and/or wherein the PITP domains are defined as follows: ENFD from A32 to R164; SR1 from E165 to K237, HbD from V238 to L396, SR2 (including C-terminal LPXT(G) motif (i.e. including LPXT, but not the G)) from S397 to T430, and hLAR from G431 to I467 in the sequence of Q6A9N1 or any other functional PITP sequence comprising all these domains, especially the PITP sequences of Fig.12 comprising all these domains.

23. Vaccine for use according to claim 22, wherein the epitope is selected from the group consisting of R32-I41, Q38-K51, T43-K51, Q38-K51, R87-K90+S234-G250, R87-K90+L246-A260, R87-K90+A256-E270, R87-K90+R266-T277, T117-I132, T117-A127, A144-N157, H146-A160, A148-N157, A156-A170, K166-L180, A176-T190, P186-A198, N181-E191, I216-F224, A226-A240, S234-G250, I251-I267, I264-P271, P236-G250, L246-A260, A256-E270, S234-G250, I251-L267, A268-L280, R266-T277, T285-D290, T285-D290+V291-T300, T285-D290+A301-E307, V291-T300, A301-E307, T285-T300, R286-D290+V291-T300, R286-D290+A301-E307, R286-T300, V289-K296, A310-D313+V289-K296, A310-D313+V289-K296, A310-D313+T285-T300, A310-D313+A144-N157, A310-D313+T285-R286, A310-D313+T285-D290, A310-D313+T293-E307,T285-D290, V291-T300, T293-E307, A301-E307 of DsA1; L152-Q166, G190-P230, I199- D208, P230-Q244, L311-T321, L311-K323, H254-H262, Q256-H262, E261-D269, D269-S279, K313-K323, of DsA2; D79-T90, E73-D85, P86-E92, F81-D89, E73-W98, E73-F81, P72-F81, A129-F138, D120-Q134, P116-T124, P131-D137, Q198-K203, K174-A188, K174-K185, P183-P201, P183-K191, K185-P195, R216-T225, K197-K203, P168-T175, R164-K174, S285-P288+G305-L314, S285-P288+H306-L314, S285-P288+T342-T351, S285-P288+D338-D348, D287-S300, T342-T351, D338-D348, H306-L314, T406-I415, of PITP, preferably wherein the epitope comprises at least one additional amino acid residue at the N- or C-terminus of the DsA1, DsA2, or PITP sequence, especially wherein the epitope comprises at least two additional amino acid residue at the N- or C-terminus of the DsA1, DsA2, or PITP sequence; wherein the polypeptide is preferably covalently linked to a carrier or scaffold molecule, especially a carrier polypeptide.

24. DsA1 and/or DsA2 and/or PITP, and/or a fragment and/or a derivative of DsA1 and/or DsA2 and/or PITP according to any one of claims 5 to 23, optionally contained in a vaccine or pharmaceutical formulation, comprising an N-terminal methionine amino acid residue.

25. DsA1 and/or DsA2 and/or PITP, and/or a fragment and/or a derivative of DsA1 and/or DsA2 and/or PITP according to any one of claims 5 to 24 for use in a therapeutic treatment, preferably for use in the treatment or prevention of *P. acnes*-associated infections, especially selected from the group consisting of(i) selected from the group consisting of: acne vulgaris, keratitis, synovitis acne pustulosis hyperostosis osteitis (SAPHO) syndrome, endocarditis, prosthetic joint infections, surgical wound infections, vascular graft infections, anaerobic arthritis, cardiovascular device-related infections, such as prosthetic valve endocarditis; ocular implant infections, breast implant illness, sciatica, conjunctivitis, shunt-associated and/or spinal hardware central nervous system infections, shunt-associated central nervous system infections, sarcoidosis, endophthalmitis osteomyelitis, allergic alveolitis, rheumatoid arthritis, infectious arthritis, chronic juvenile arthritis, chronic destructive oligoarthritis, degenerative disc disease, dental infections, ulcerative colitis hyperpyrexia, cerebral abscess, subdural empyema, peritonitis, periodontitis, endodontic infections, endophthalmitis, keratitis, chronic rhinosinusitis, folliculitis, keratitis, corneal ulcer, endophthalmitis, prostate inflammation, chronic prostatitis, primary biliary cirrhosis, hidradenitis suppurativa, pulmonary angitis, acne

inversa, progressive macular hypomelanosis, acne conglobata, atherosclerosis, prostatic cancer, and a medical implant biofilm infection by P. acnes.; and/or

26. DsA1 and/or DsA2 and/or PITP, and/or (ii) a fragment and/or a derivative of DsA1 and/or DsA2 and/or PITP according to any one of claims 5 to 24 for use in the treatment or prevention of *P. acnes*-associated infections in a human patient suffering from *P. acnes*-associated infections and pathological conditionscondition associated with any of Type I, II, or III *P. acnes*, or a combination of at least two phylotypes of Type I, II and III, or of at least two ribotypes of *P. acnes*, preferably for use as a cross-reactive vaccine*acnes*, especially a cross-type-reactive vaccine, against *P. acnes*, especially for the treatment or prevention of infections in a human patient suffering from *P. acnes*-associated infections and*P. acnes*-associated infection or pathological conditions associated with Type IB, and III of *P. acnes*.

27. Vaccine or polypeptide according to any one of claims 5 to 26, wherein the DsA1 and/or DsA2 and/or PITP, and/or a fragment or derivative of DsA1 or DsA2 or PITP is provided as DNA or RNA encoding an antigen or an epitope containing fragment or derivative thereof, preferably as mRNA vaccine, especially an mRNA vaccine formulated with cationic polymers, with an mRNA molecule with the following structure: 5'UTR-signal peptide-encoded antigen or epitope-3'UTR; or as a vector-based vaccine, especially with an adenovirus vector, an adeno-associated virus vector, a vesicular stomatitis virus vector, a Newcastle Disease virus vector, an alphavirus vector, a baculovirus vector, or a retrovirus vector; and/or wherein the coding sequence on DNA level has the initial coding DNA sequence ATGGTG; especially wherein the mRNA comprises a sequence as transcribed from SEQ ID NOs: 67 to 76.

28. Pharmaceutical formulation comprising a vaccine or polypeptide according to any one of claims 5 to 27 comprising the polypeptide as defined in any one of these claims, i.e. a DsA1 and/or DsA2 and/or PITP, and/or a fragment and/or a derivative of DsA1 and/or DsA2 and/or PITP according to any one of claims 1 to 27 or mixtures thereof; and a pharmaceutically acceptable excipient or carrier.

29. Method of treatment or prevention of *P. acnes*-associated infections in a human patient suffering from *P. acnes*-associated infections and pathological conditions associated with any of Type I, II, or III *P. acnes*, or a combination of at least two phylotypes of Type I, II and III, or of at least two ribotypes of *P. acnes*, preferably for use as a cross-reactive vaccine, especially a cross-type-reactive vaccine, against *P. acnes*, especially for the treatment or prevention of infections in a human patient suffering from *P. acnes*-associated infections and pathological conditions associated with Type IB, and III of *P. acnes* comprising administration of an effective amount of a DsA1 and/or DsA2 and/or PITP, and/or a fragment and/or a derivative of DsA1 and/or DsA2 and/or PITP according to any one of claims 5 to 27 or mixtures thereof in an effective amount to a patient in need thereof.

24. 30. Method according to claim 29, wherein The use of claim 23, wherein:

(i) the human subject is a child, an adolescent or an adult;

(ii) the treatment regimen involves a prime and boost immunization, preferably wherein the same formulation is used for the prime and boost administration;

(iii) administration is performed by intradermal, subcutaneous (s.c.), parenteral, intramuscular (i.m.), mucosal, transcutaneous or topical administration, preferably by intradermal, or intramuscular administration, especially by a syringe or by microneedelingmicroneedling devices.

31. Method25. A method of production of the polypeptides, vaccines and formulations according to polypeptide of any one of claims 5 to 281-10, wherein the polypeptides comprising at least one P. acnes epitope as defined in these claims arepolypeptide is expressed in a host cell, extracted and purified from thesethe host cellscell, and, optionally, formulated and finished to a pharmaceutical formulationcomposition, especially e.g., a vaccine for use in the treatment or prevention of P. acnes-associated infections in a human patient.

32. Use of DsA1 and/or DsA2 and/or PITP, and/or a fragment and/or a derivative of DsA1 and/or DsA2 and/or PITP according to any one of claims 5 to 27 or mixtures thereof for the manufacture of a medicament for treatment or prevention of *P. acnes* associated infections in a human patient suffering from *P. acnes*-associated infections and pathological conditions associated with any of Type I, II, or III *P. acnes*, or a combination of at least two phylotypes of Type I, II and III, or of at least two ribotypes of *P. acnes*, preferably for use as a cross-reactive vaccine, especially a cross-type-reactive vaccine, against *P. acnes*, especially for the treatment or prevention of infections in a human patient suffering from *P. acnes*-associated infections and pathological conditions associated with Type IB, and III of *P. acnes*.