



Immunogenicity of Bacterial Protoplasmic Sonicate Proteins

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Bacterial Protoplasmic Sonicate Proteins BPSP were recovered from skin burn *Pseudomonas aeruginosa* and *Klebsiella oxytoca* infections. These proteins were considered as immunogens in rabbits. Mucosal and systemic, humoral and cellular immune responses were matched. The *P. aeruginosa* protoplasmic sonicate proteins induces an increase in; NBT % neutrophil phagocytosis, significant leukocyte migration inhibition cytokines, IL6 cytokine elevation and rise up of humoral agglutinins responses. While, *K. oxytoca* protoplasmic sonicate proteins induces increase of; humoral agglutinins and IL6 cytokine as well as non-significant increase in leukocyte inhibitory cytokines. Both at mucosal and systemic compartments. The study highlights the potentials of these proteins as candidates for developing vaccines against multidrug resistance infections, particularly in burn patients. These findings underscore the importance of immunogenicity in advancing bacterin development in clinical use.

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1. INTRODUCTION

Bacterial antigens [BAGs] were being investigated to be of use in, bacterial diagnosis, bacterial infection diagnosis, vaccine development and vaccine production. Immunogenicity of BAGs holds a backbone position in vaccine development strategies [1–7]. The objective of the present work was the investigation of immunogenicity of protoplasmic sonicate protein antigens of skin burn infections with *P. aeruginosa* and *K. oxytoca*.

2. MATERIALS AND METHODS

2.1 Protoplasmic Sonicate Protein Antigens P SPA

The PSPA separation was in direct way for *P. aeruginosa* [8], while, by in direct way as it needs removal of the capsule [9,10] before processing for obtaining PSPs. The method for separation, identification, purification and quantitation of these PSPs were as in the method described by Bjorn et al. [8]. The details of the processing method was as in the followings; Six mls of tris buffer 0.01 N and PH 8 was added to the surface of 24 hrs growth of *P. aeruginosa* and *K. oxytoca* (after suspending bacteria then removal of capsule [9,10]) on the nutrient agar plates. Growth were vortexed in vortex test tubes for three minutes. Suspensions were centrifuged at 5000 rpm for ten minutes. Supernatant were discarded and pellets Ps were kept. Ps suspensions were tubbed and washed three times with tris buffer 0.01N. Ps were reconstituted with 6 mls, and were tubbed in the cell disintegrator tubes. Then jacketed with cooled ice. The best sonication conditions were five times for five minutes at 20 oscillation amplitude. The sonicated cell suspensions were centrifuged at 5000 rpm for ten minutes. Supernats were collected and ultrafiltered with 0.22 um millipore filter. Fiterates were collected in sterile plastic tubes, then proteins were separated with PEG 6000 ,6% as in Shnawa and AlSadi [11]. The protein concentration determination was measured by Biurt test [12]. To this end the preparations can be designated as PAPSP and KOPSP both *P. aeruginosa* and *K. oxytoca* respectively. These PSPs were distributed into alliquotes of 0.5 mls. In an appendroff plastic tubes and kept at -20C, till use.

2.2 Immune Reagents

Specific immune priming of rabbits were done with the PSP concentrations of 2.71 mg/l for PAPSP and 1.8 md/l for KOPSP [12]. The somatic antigens for both bacteria were prepared as heat killed as in [13]. Complete Freund Ajuvant that from Difco, Co.Ltd. The test proposed immunogens were made as; one volume of CFA mixed with one volume the test proteins Immunization Protocols

2.3 Immunization Protocols

A mounthwise twice dosage of PSP-CFA in 2 mls amounts were dosaged in the first and second months to the rabbits. The specific immune priming was that of multisite injection protocol [14].

2.4 Rabbits

A local breed rabbits brought from the local market were checked for ecto and endoparasites. As well as for pyrogens and found to be free off. They were acclimatized for housing conditions two weeks before experimentation at and libitum conditions. Among which nine were elected and subdivided into two test and one control group each of three rabbits.

2.5 Samplings and Immune Function Tests

At the temination of the specific immune priming protocols, blood with and with out heparin were collected from the test and control rabbits by cardiac puncture for humoral and cellular immune tests. Sera were saved for serology and cytokine studies. Heparinized blood were used for leukocyte inhibitory factor [15] and for NBT phagocytosis [16]. Appendix for test and control rabbits were collected and open up, washed from digesta and processed for separation of mucosal globulins [17]. Mucosal leukocytes were separated by dextran 2% as in [18]. IL 6 determinations were made as in the recommendation of the instruction of the manufacturer. Standared tube agglutination test were made as in [19].

3. RESULTS

The NBT neutrophil phagocytosis percentages in PAPSPA (56.75 % for mucosal and 36.5 for

systemic) and KOPSPA (48.5% for mucosal, 41% for systemic) primed rabbits were higher than that of control rabbits (20% for mucosal, 18% for the systemic). Leukocyte inhibitory cytokine LIF % in PAPSP primed rabbits were 56.6% for mucosal and 58.45 for systemic as compared to control, the mucosal was 90% and systemic was 86%. While for KOPSPA primed rabbits were; 88% for mucosal and 87.5% for systemic LIF as compared to normal control were 93% for mucosal and 89% for systemic responses. The IL6 concentration determinations were shown that PAPSPA and KOPSPA primed rabbits have got higher IL6 concentration means than normal control rabbits. PAPSPA primed rabbits IL6 concentration means were 92.8 for mucosal and 72.7 for systemic responses. In KOPSPA primed rabbits the mucosal concentration means were 83.26 and for systemic were 76.79 as compared to normal control were 8.83 for mucosal and 9.25 for systemic responses. The humoral specific agglutinin titre levels for PAPSPA were 128 for mucosal and 320 for the systemic responses and KOPSP primed rabbits were 64 for mucosal and 640 for systemic responses as compared to control rabbits were 4 for mucosal and 20 for systemic responses. Mucosal agglutinins were resistant to treatment with 2ME, Tables 1 and 2.

4. DISSCUSSION

The concept, application and continuity of the immunogenicity theme for bacterial protein

antigens are still in the current mode of researchers all over the world [1-7]. Immunogenicity appeared to have two main facets. First that of theoretical immunologists which advocate that immunogenicity is denoted to self-nonself recognition theme [6]. While the second facet was that for most of the proper immunologists which can be summarized as the ability of an antigen to initiate humoral and/or cellular conversion from the normal baseline immune functions to an optimized cellular immune reactions outcomes that are finalized by the optimum synthesis and production of cellular secretory proteins (antibodies, cytokines) concentrations and/or optimized depression of such secretory proteins [1-5,7]. Immunogenicity appeared to be essential for diagnosis and prophylaxis of human infections as well as in cancer personalized prophylactic and therapeutic medicine. Hence the present study for *Pseudomonas* and *Klebsiella* immunogenicity may participate in developing of a prototype bacterial protein based vaccine and/or in development for an autovaccine for multidrug resistant skin burn infection [20].

The antigenic make up of bacteria [1-5,7] like that of *P. aeruginosa* are formed from; flagella, pili, exotoxin A, exopolysaccharide, LPS, OMP, hemolysin, elastases, proteases, heat stable phospholipid, heat stable glycolipid, exoenzyme S and ribosome [21-23]. While that of *Klebsiella oxytoca* are; capsule, somatic antigens and LPS [24]. Hence, PAPSP and KOPSP protein

Table 1. The immunogenicity of PAPSP in primed rabbits and controls

Rabbits groups	NBT%	LIF%	IL6 pg/ml.	Agglutinin titres
PAPSPA				
M	46.75	56.6	2.8	128
S	36.6	58.45	72.7	320
Control				
M	20	93	92.8	4
S	18	89	72.7	20

Table 2. The immunogenicity of KOPSP in primed and control rabbits

Rabbit groups	NBT%	LIF %	IL6 pg/ml	Agglutinin titres
KOPSPA				
M	48.5	88	48	64
S	41	87	72	640
Controls				
M	20	93	8.83	4
S	18	89	9.25	20

Table 3. The immune features of the study bacterial proteins

Features	PAPSP [25]	KOPSP [25]
1-Chemical nature	Protein	Protein
2-Origin	Bacterial	Bacterial
3-Location	Intracellular	Intracellular
4-Processing method	Ultrasonication	Ultrasonication
5-Non-specific immune function	Rise up of phagocytosis By NBT%	Rise up of phagocytosis by NBT %
6- Specific cellular immune function	Significant inhibition of LIF cytokine	Nonsignificant inhibition of LIF cytokines
7-Induction of cytokine network	Rise up of IL6 cytokine	
8-Humoral Immune responses	Rise up of specific agglutinins	Rise up of IL6 cytokines
9-Functional Epitope Mapping [26,27]	T cell dependent and T cell independent epitopes	Rise up of specific agglutinins T cell independent and /or, TH2 dependent B cell epitope
10-Immune system compartments	Mucosal and Systemic	Mucosal and systemic
11-Expected Immune potentials [20]	Prototype protein based vaccine and an autovaccine	Prototype protein based vaccine and an autovaccine.

antigens are novel antigens prepared in this experimental settings.

PAPS was proved to be immunogenic in rabbits model, Table 1, promoting humoral and cellular immune responses both at mucosal and systemic compartments. These findings were in contradiction with that of [24]. While, KOPSP immunogenicity, Table 2, were by promoting humoral immune responses both at mucosal and systemic level [21]. Different burn infecting bacterial protein preparations have shown different immune potential features, Table 3,[25]. The functional epitope mapping for PAPSP may be T cell dependent and T cell independent, while that of KOPSP may be of T cell independent or Th2 cell dependent B cell epitopes [26,27]. Since immunogenicity is an integral part for developing bacterins. Such findings holds the position of novelty, based upon the need for an autogenous bacterins for multidrug resistant skin burn bacterial infections [28,29].

5. CONCLUSIONS

P. aeruginosa PAPSP and *K. oxytoca* KOPSP protoplasmic sonicate proteins were found as lapin immunogens. PAPSP mediate humoral and cellular immune responses both at mucosal and systemic compartments. While, KOPSP mediate humoral immune responses both at mucosa and blood stream. These proteins may be of expected immune potentials as protein based vaccine candidate and as an autovaccine for multidrug resistant skin burn infections.

DISCLAIMER

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILO, etc) and text-to-image generations have been used during writing or editing of this manuscript.

CONSENT

It is not applicable.

ETHICAL APPROVAL

The housing, handling and interventions on rabbits were done following the international acts for regulation of housing, handling and interventions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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