"Biotechnologia Acta" V. 9, No 6, 2016
https://doi.org/10.15407/biotech9.06.007
P. 7-15, Bibliography 66, English
Universal Decimal Classification: 604.4:615.371



THE APPROACHES TO DESIGNING OF NEW GENERATION VACCINES AGAINST THE SHEEP POX DISEASE

E. F. Yilmaz [1], P. P. Arayici [1], A. M. Maharramov [2], Z. Mustafaeva [1]

[1] Yildiz Technical University, Istanbul, Turkey

[2] Baku State University, Azerbaijan

In this review the authors analyzed the sheep pox disease, which occurs outbreaks all over the world particularly in Asia and Africa causing substantial losses in trade of animal and animal products. They categorized the sheep pox disease is one of the prioritized groups of diseases against which the World Organization for Animal Health is fighting. Data concerning a sheep poxes' history, epidemiology, epizootiology, mortality and economic impact, clinical and pathological signs, features of capripoxvirus that forms the disease are given. Diagnosis treatment and vaccine have been investigated as well. The main conclusion is done according which the designing of new vaccine generation against the sheep pox disease could be as an alternative approach against sheep pox.

Ключові слова: Sheep pox, synthetic peptide vaccines, Capripoxvirus, Polymeric adjuvant.

© Palladin Institute of Biochemistry of National Academy of Sciences of Ukraine, 2016

{spoiler title=References}

1. 1. *Babiuk S., Bowden T. R., Boyle D. B., Wallace D. B., Kitching R. P.* Capripoxviruses : An Emerging Worldwide Threat to Sheep,Goats and Cattle. *Transbound. Emerg. Dis* . 2008, 55 (7), 263–272. https://doi.org/10.1111/j.1865-1682.2008.01043.x

2. 2. *Hasoksuz M., Gulyaz V., Sarac F.* Molecular Characterizations of Sheeppox Virus Strains. *Transbound. Emerg. Dis*. 2014, 55 (7), 63–72. https://doi.org/10.16988/iuvfd.81058

3. 3. *Barut F.* Sığırların Nodüler Ekzantemi Lumpy Skin Disease (LSD) Hastalık Kartı. Etlik Veteriner Kontrol Merkez Araştırma Enstitüsü Virolojik Teşhis Laboratuvarı, from http://docplayer.biz.tr/17564685-Sigirlarin-noduler-ekzantemi-lumpy-skin-disease-lsd-hastalik-karti-hazirlayan-dr-m-fatih-barut-vet-hekim.html (accessed, December 2016).

4. 4. *Gulyaz V., Ozdemir S.* Kombine Hazırlanan Koyun Çiçek Ve Koyun-Keçi Vebası Aşısının Bağışıklık. *Pendik Vet. Mikrobiyol. Derg*. 2010. 37 (1), 3–9.

5. 5. *Sozdutmaz İ.* Koyun-Keçi Çiçeği Hastalığının Polimeraz Zincir Reaksiyonu ile

Tanısında Farklı Klinik Örneklerin Kullanımı. *Atatürk Üniversitesi Vet. Bil. Derg* . 2010, 5 (3), 113□119.

6. 6. *OIE,* W.O.F.A.H., Manual of Diagnostic Tests and Vaccines for Terrestrial Animals Sheep pox and goat pox. Chapter 2. July 7, 2008, from www.oie.int/doc/ged/D7710.PDF.

7. 7. *Varshovi H. R., Keyvanfar H., Aghaiypour K., Pourbakhsh S. A., Shooshtar A. H., Aghaebrahimian M.* Capripoxvirus identification by PCR based on P32 gene. *Arch. Razi Insti* . 2009, 64 (1), 19□25.

8. 8. *Bhanuprakash V., Indrani B. K., Hosamani M., Singh R. K.* The current status of sheep pox disease . *Com p. Immunol. Microbiol. Infect. Dis.* 2006, V. 29, P. 27–60. https://doi.org/10.1016/j.cimid.2005.12.001

9. 9. *Rao T. V. S., Bandyopadhyay S. K. A.* Comprehensive review of goat pox and sheep pox and their diagnosis . *Anim. Health Res. Rev* . 2000, 1 (2), 127–136. https://doi.org/10.1017/S1466252300000116

10. 10. *Sozdutmaz İ.* Virological, serological and epizootiological investigations of sheep pox and goat pox diseases in northeast anatolian region (Doctoral dissertation). Available from https://tez.yok.gov.tr/UlusalTezMerkezi/. 2010. (No. 260529).

11. 11. *Cam V. M.* Control of capripoxvirus infections. *Vaccine.* 1993, 11 (13), 1275–1279. https://doi.org/10.1016/0264-410X(93)90094-E

12. 12. *Yilmaz H., Turan N., Hasoksuz M.* Viroloji Ders Notu. İ. Ü. Veteriner Fakültesi Viroloji Anabilim Dalı. Available at http://veteriner.istanbul.edu.tr/wp-content/./VİROLOJİ-DERS-notu-Kitabı-27.12.2013.pdf (accessed, December 2016)

13. 13. *Parthıban M., Govındarajan R., Manoharan S., Purushothaman V., Chandran N. D. J., Koteeswaran A.* Comparative sequence analysis of diagnostic PCR amplicons from Indian sheeppox virus . *Vet. Arhiv.* 2005, N 75, P. 203–209.

14. 14. *Aldaiarov N., Stahel A., Nufer L., Jumakanova Z., Tulobaev A., Ruetten M.* Outbreak of sheeppox in farmed sheep in Kyrgystan: Histological, eletron micro- scopical and molecular characterization. *Schweizer Arch. Tierheilkunde.* 2016, 158 (7), 529-532. https://doi.org/10.17236/sat00076

15. 15. *Paul G., Kelly L., Snary E.* Qualitative assessment for the release of sheep pox virus and lumpy skin disease virus into Great Britain from the European Union. *AHVLA.* February 2014, from https://www.gov.uk/government/.../qa-sheeppox-gb.pdf (accessed, December 2016).

16. 16. *Bhanuprakash V., Venkatesan G., Balamurugan V., Hosamani M., Yogisharadhya R., Chauhan R. S., Pande A., Mondal B., Singh R. K.* Pox outbreaks in Sheep and Goats at Makhdoom (Uttar Pradesh), India: Evidence of Sheeppox Virus Infection in Goats . *Transbound. Emerg. Dis* . 2010, N 57, P. 375–382. https://doi.org/10.1111/j.1865-1682.2010.01158.x

17. 17. *OIE,* Sheep Pox and Goat Pox in Greece. 2014, from http://www.oie.int/wahis_2/public/wahid.php/Reviewreport/Review?page_refer=MapFullEventReport&reportid=14914 (accessed, December 2016).

18. 18. *Boshra H., Truong T., Nfon C., Gerdts V., Tikoo S., Babiuk L. A., Kara P., Mather A., Wallace.,□ Babiuk S.* Capripoxvirus-vectored vaccines against livestock diseases in Africa. *Antivir. Res.* 2013, N 98, P. 217–227.

19. 19. *Diallo A., Viljoen G. J.* Genus Capripoxvirus. *Poxviruses.* 2007, P. 167–181. doi: 10.1007/978-3-7643-7557-7_8. https://doi.org/10.1007/978-3-7643-7557-7_8

20. 20. *Tian H., Chen Y., Wu J., Shang Y., Liu X.* Serodiagnosis of sheeppox and goatpox using an indirect ELISA based on synthetic peptide targeting for the major antigen P32. *Virol. □ J.* 2010, N 7, P. 245. doi: 10.1186/1743-422X-7-245. https://doi.org/10.1186/1743-422X-7-245

21. 21. *Arda M.* Fundamental Microbiology. *Medisan Publising House*. Ankara. 2006.

22. 22. *Hendrix R. W., Casjens S. R.* The Double Stranded DNA Viruses. Virus Taxonomy. 2005. Available at: http://dx.doi.org/10.1016/B978-0-12-249951-7.50010-9 (accessed, July, 2016). https://doi.org/10.1016/B978-0-12-249951-7.50010-9

23. 23. *Haegeman A., Zro K., Sammin D., Vandenbussche F., Ennaji□ M.□ M., Clercq D. K.* Investigation of a Possible Link Between Vaccination and the 2010 Sheep Pox Epizootic in Morocco. *Transbound. Emerg. Dis*. 2016, 63 (6), 278–287. https://doi.org/10.1111/tbed.12342

24. 24. *Venkatesana G., Balamurugana V., Bhanuprakasha V.* Multiplex PCR for simultaneous detection and differentiation of sheeppox, goatpox and orf viruses from clinical samples of sheep and goats.

J. Virol. Meth.
2014, V. 195, P. 1–8.
https://doi.org/10.1016/j.jviromet.2013.10.009

25. 25. *Zro K., Azelmat S., Bendouro Y., Kuhn J. H., Fahime E. E., Ennaji M. M.* PCR-based assay to detect sheeppox virus in ocular, nasal, and rectal swabs from infected Moroccan sheep.
J. Virol. Meth.
2014, N 204, P. 38–43.
https://doi.org/10.1016/j.jviromet.2014.03.019

26. 26. *Lamiena C. E., Lelenta M., Gogerb W., Silber R., Tuppurainend E., Matijevice M., Luckinsa A. G., Diallo A.* Real time PCR method for simultaneous detection, quantitation and differentiation of capripoxviruses. *J. Viro l. Meth.*
2011, N 171, P. 134–140.
https://doi.org/10.1016/j.jviromet.2010.10.014

27. 27. *Venkatesan G., Balamurugan V., Bhanuprakash V.* TaqMan based real-time duplex PCR for simultaneous detection and quantitation of capripox and orf virus genomes in clinical samples *. J. Virol. Meth.* 2014, N 201, P. 44–50.
https://doi.org/10.1016/j.jviromet.2014.02.007

28. 28. *Venkatesan G., Balamurugan V., Bhanuprakash V., Singh R. K., Pandey A. B.* Loop-mediated isothermal amplification assay for rapid and sensitive detection of sheep pox and goat pox viruses in clinical samples
.
Mol. Cell. Probes.
2016, V. 30, P. 174–177.
https://doi.org/10.1016/j.mcp.2016.02.004

29. 29. *Capstick P. B., Coackley W.* Protection of cattle against lumpy skin disease I-Trials with a vaccine against Neethhng type infection.
Res. Vet. Sci.
1961, N 2, P. 362–368.

30. 30. *Davies F. G., Kitching R. P, Hammond J. M., Taylor W. P.* In A single vaccine for the control of capripox refection m sheep and goats.
Res. Vet. Sci.
1986, N 42, P. 53–60.

31. 31. *Boumart Z., Daouam S., Belkourati I., Rafi L., Tuppurainen E., Tadlaoui K. O., Harrak M. E.* Comparative innocuity and efficacy of live and inactivated sheeppox vaccines. *BMC Vet. Res.* 2016, V. 12, P. 133–139. https://doi.org/1

0.1186/s12917-016-0754-0

32. 32. *Buyuktanır O.* Current Biotechnological Bacterial Vaccines. *Atatürk Üniversitesi Vet. Bil. Derg.* 2010, 5 (2), 97–105.

33. 33. *Akbuga J.* Farmasötik Biyoteknoloji Ürünleri. *MİSED.* 2002, 3 (4), 54–62.

34. 34. *Altınsoy N.* Aşı Üretim Teknikleri ve Kontrolü. A.Ü. Veteriner Fakültesi, Mikrobiyoloji, 2007. Available at: http://nihanaltinsoy.tr.gg/A%26%23351%3B%26%23305%3B--Ue-retim-Teknikleri-ve-Kontrol.ue.htm (accessed, September, 2016).

35. 35. *Mayda G.* DNA Vaccines. *Güncel Gastroentoroji.* 1997, October, P. 406–411.

36. 36. *Kuyucu N.* Vaccines in Future. *J. Klinik Gelişim.* 2012, V. 25, P. 44–48.

37. 37. *Karayel İ., Alkan F.* DNA Vaccines and Their Using in Veterinary Medicine. *Van Vet. J.* 2015, 26 (3), 177–182.

38. 38. *Kızılbey K.* Conjugation of melanoma based synthetic peptides with polyacrylic acid and their copolymers (Doctoral dissertation). Available from https://tez.yok.gov.tr/UlusalTezMerkezi/. 2012. (No. 312221).

39. 39. *Chervyakova O. V., Zaitsev L. V., Iskakov B. K., Tailakova E. T., Strochkov V. M., Sultankulova K. T., Sandybayev N. T., Stanbekova G. E., Beisenov D. K., Abduraimov O. Y., Mambetaliyev M., Sansyzbay A. R., Kovalskaya N. Y., Nemchinov L. G., Hammond R. W.* Recombinant Sheep Pox Virus Proteins Elicit Neutralizing Antibodies. *Viruses.* 2016, 8 (6), 159. https://doi.org/10.3390/v8060159

40. 40. *Henderson L. M.* Overview of marker vaccine and differential diagnostic test technology . *Biologicals.* 2005, V. 33, P. 203–209. https://doi.org/10.1016/j.biologicals.2005.08.006

41. 41. *Liljeqvist S., Stahl S.* Production of recombinant subunit vaccines: protein immunogens, live delivery systems and nucleic acid vaccines. *J. Biotechnol.* 1999, N 73, P. 1–33. https://doi.org/10.1016/S0168-1656(99)00107-8

42. 42. Peptide Calculator. Available at: http://www.bachem.com/service-support/peptide-calculator/. (accessed, February, 2017).

43. 43. *Mustafaev M., Mustafaeva Z., Ergen E., Uraki Y., Sano Y.* Novel betulin-containing polyelectrolyte Conjugates .
J. Bioact. Compatible Polym. 2002, V. 17, P. 251–269.

https://doi.org/10.1106/088391102027122

44. 44. *Li W., Joshi D. M., Singhania S., Ramsey K. H., Murthy A. K.* Peptide Vaccine: Progress and Challenges.
Vaccines.
2014, N 2, P. 515–536.
https://doi.org/10.3390/vaccines2030515

45. 45. *Ozdemir Z. O., Karahan M., Karabulut E., Mustafaeva Z.* Characterization of Foot-and-Mouth Disease Virus's Viral Peptides With LC-ESI-MS.
J. Chem. Soc. Pak.
2010, 32 (4), 531–536.

46. 46. *Basak I. E., Yasemin B. K., Zeynep M. A.* Bioconjugation of Hepatitis B antigenic peptide with polymeric carriers through various carbodiimide chemistry
.
Turkish J. Biochem.
2011, N 36, P. 222–229.

47. 47. *Moisa A. A., Kolesanova E. F.* Synthetic Peptide Vaccines. Insight and Control of Infectious Disease in Global Scenario. *P. K. Roy (Ed.).* 2012,
P. 201–228. doi: 10.5772/33496.
https://doi.org/10.5772/33496

48. 48. *Can F., Arayıcı P. P., Karahan A., Mustafaeva Z., Mamedov B.* The Current Approaches To Zika Virus Vaccination.
Biotechnol. acta.
2016, 9 (4).
https://doi.org/10.15407/biotech9.04.007

49. 49. *Scorza F. B., Tsvetnitsky V., Donnelly J. J.* Universal influenza vaccines: Shifting to better vaccines. *Vaccine.* 2016, 34 (16), 2926–2933.
https://doi.org/10.1016/j.vaccine.2016.03.085

50. 50. *Jakubke H., Sewald N.* Peptides from A to Z:A Concise Encyclopedi. 2008. *Wein heim, Wiley-Vch.*
https://doi.org/10.1002/9783527621187

51. 51. *Yu H. M., Chen S. T., Wang K. T.* Enhanced Coupling Efficiency in Solid-Phase Peptide Synthesis by Microwave Irradiation. *J. Org. Chem.*
1992, 57 (18), 4781–4788.
https://doi.org/10.1021/jo00044a001

52. 52. *Ozdemir Z.* Developing bioconjugates which based on polyelectrolytes, using synthetic viral peptides (Doctoral dissertation). Available from https://tez.yok.gov.tr/UlusalTezMerkezi/. 2008. (No. 238986).

53. 53. *Derman S., Mustafaeva A. Z., Abamor S. E., Bağırova M., Allahverdiyev A.* Preparation, characterization and immunological evaluation: canine parvovirus synthetic peptide loaded PLGA nanoparticles.
J. Biomed. Sci.
2015, 22 (89).
https://doi.org/10.1186/s12929-015-0195-2

54. 54. *Mustafaev M.* Functionally Biopolymer Systems. *Sigma J. Engin. Nat. Sci.* 2004, V. 4, P. 1–201.

55. 55. *Mustafaev M. I.* Biopolymers. *TÜBİTAK Marmara* Research Center *(MAM) Publishing House.*
1996.

56. 56. *Dilgimen A. S., Mustafaeva Z., Demchenko M., Kaneko T., Osada Y., Mustafaev M.* Water-Soluble Covalent Conjugates of Bovine Serum Albumin With Anionic Poly(N-Isopropyl-Acrylamide) and Their Immunogenicity. *Biomaterials.* 2001, 22 (17), 2383–2392.
https://doi.org/10.1016/S0142-9612(00)00425-7

57. 57. *Kılınc Y. B., Mustafaeva Z. M., Koç R. Ç., Bağırova M., Allahverdiyev A.* Synthesis and characterization of antigenic influenza A M2e protein peptide-poly(acrylic) acid bioconjugate and determination of toxicity in vitro.
Bioengineered.
2014, 5 (6), 357–362.
https://doi.org/10.4161/21655979.2014.969131

58. 58. *Topuzogullari M., Koc R. C., Isoglu S. D., Bagirova M., Mustafaeva Z.* Conjugation, characterization and toxicity of lipophosphoglycan-polyacrylic acid conjugate for vaccination against leishmaniasis.
J. Biomed. Sci.
2013. 20 (1), 35–43.
https://doi.org/10.1186/1423-0127-20-35

59. 59. *Mansuroğlu B., Mustafaeva Z.* Characterization of water-soluble conjugates of polyacrylic acid and antigenic peptide of FMDV by size exclusion chromatography with quadruple detection. *Mat. Sci. Engin.* 2012, 32 (2), 112–118. https://doi.org/10.1016/j.msec.2011.10.004

60. 60. *Mustafaev M., Osada Y., Matsukata M., Basalp A., Çirakoglu B., Bermek E.* New amphiphilic immunogens by Cu2+-mediated complexes of water-born poly(N-isopropylacrylamide) and bovine serum albumin.

J. Biocat. Compet. Polym.
1998. V. 13, P. 33–49.

61. 61. *Mustafaev M. I., Yücel F., Öztürk S., Çirakoğlu B., Bermek E.* Immune response to progesterone involved in Cu 2+-mediated polyanion-protein complex—antigen specificity and affinity of hybridoma clones
.
J. Immunol. Lett.
1996, N 52, P. 63–68.

62. 62. *Karahan M., Ozturkcan S. A., Mustafaeva.* Z. Antitumor activity of polyelectrolytes-metal complexes. *Ro man. Biotechnol. Lett.*
2013, 18 (4), 8447–8455.

63. 63. *Karahan M., Mustafaeva Z., Ozeroglu C.* The formation of polycomplexes of poly(methyl vinyl ether-CO-maleic anhydride) and bovine serum albumin in the presence of copper ions. *Polish J. Chem. Technol.*
2014, 16 (3), 97–105.
https://doi.org/10.2478/pjct-2014-0058

64. 64. *Kadriye K., Serap D., Mustafaeva Z.* Poly (N-vinyl-2-pyrrolidone-co-acrylic acid): Comparing of “Traditional Heating” and “Microwave-Assisted” Free Radical Polymerization
. *J. Chem. Soc. Pak.*
2013, 35 (14), 1191–1196.

65. 65. *Derman S., Kızılbey K., Mansuroğlu B., Mustafaeva Z.* Poly(N-Vinyl-2-Pyrrolidone-co-Acrylic Acid)-Bovine Serum Albumin Complex Formation Studied by HPLC and UV/Vis Spectroscopy
.
Roman. Biotechnol. Lett.
2011, 17 (4), 7408–7417.

66. 66. *Mustafaeva Z.* Polymers In Vaccine Formulation. *Sigma J. Eng. Nat. Sci.* 2016, 34 (3), 439–451.

{/spoiler}