Available online **www.ijpras.com**

International Journal of Pharmaceutical Research & Allied Sciences, 2016, 5(3): 352-355

Review Article

ISSN : 2277-3657
CODEN(USA) : IJPRPM

Application of Peptide Compounds as Anti-Bacterial Agent versus Bacteria

Seyyedeh Omolbanin Sharifi Gharbi[1], Masumeh Jamshidi[2], Marziyeh Kiani[2] and Mohammad Ali Shariati[3]

[1]Young Researchers and Elite Club, Tonekabon Branch, Islamic Azad University, Tonekabon, Iran [2]Department of Food Science and Technology, Nour Branch, Islamic Azad University, Nour, Iran [3]Researcher, Orel Agrarian State University, Russia
**corresponding author email:shariatymohammadali@gmail.com*

ABSTRACT

Todays, in order to extend shelf li, consumers ask for formulating food with natural preservatives instead of chemical preservatives due to their no harm affections on human. Nisin is peptide produced by Lactic acid bacteria during fermentation with anti-bacterial affects. Nisin has superior properties in comparison with chemical preservatives such as being non-toxic, natural, appropriate stability versus acid and heating. This article reviews Nisin functionality on gram positive bacteria and the mechanism of its action on cell.

Keywords: Nisin, Plasma membrane, Positive Gram

INTRODUCTION

Antibacterial peptides refer to those peptides with different numbers of amino acids and limitation of 100. Regarding the type, origin, size, and structure and activation way. They act against microorganisms vary from bacteria to viruses and etc. Aps categorizes in 4 groups β-sheet, α-helical, loop and extended peptides. Since APs mostly are rich in basic amino acid such as arginine they have a net positive charge. Perhaps may say that first time APs extracted from a basillus strain by which mice were protected against a kind of cocci infectious (1-6). During time, other antibacterial peptides discovered with affection on gram positive and negative bacteria even fungi (2, 7-14). The target organs in which APs are findable varies from type to type, for example frog skin is the source for many of them (3, 15-21).

There are several affections introduced for APs such as direct involvement in immunity, on inflammatory when infections (however antibiotic suffers from the lack of this kind property (4, 5, 22, 23) and so forth (6, 24-27). As we mentioned before α-helix, B-sheet, loop and extended are 4 discovered structures for APs (7, 28-32). In fact mostly aps belongs to one of 4 types, but some belongs to a group with no similarity to mention ones even their active form is when interact with cell walls (8, 33-37). They also may reconform in case of reaction with DNA (9, 38-41).

While APs have the possibility of protecting against pathogens, their use is still a controversial issue due to some toxicity to human (10, 42-46), affection on environment, no competitively/selectively versus some serotypes (11, 47-52). Mostly enzymatic activities are not critical property in classifying APs and they categorize based on the targeted microorganisms for each one.
Antiviral peptides may act in 3 ways including disrupting of envelopes, blocking of receptors, preventing of viral particle entrance in host's cells (12, 52-55). For viral case, APs may not have the ability of competition with glycoproteins in regards with bonding to the cell receptors. An example of antiviral peptides which is extracted from cell rabbits is NP-1 which prohibits HSV-2 (13, 56-58). Antibacterial peptides are the most studied type of APs which cause to change in integrity of the lipid bilayer structure as hydrophobic region (14, 58). In some cases of killing unsuitble microorganism, APs interfere the mechanism of some important pathways (15, 59-61). For example, Drosocin with its 18-20 amino acids with a site for their intracellular inetractions. Nisin and Vancomysin prevent sythesizing of cell membrane.

In case of fungi, APs act differently via increasing permeability of plasma membrane (16, 62) or disrupting the cell wll through creation of direct pores in it (17, 63). Due to the presence of different structural types of atifungal peptides, it can not concluded that there is signifcant correlation between the type of antifungal structure and targetted microorganism even in case of positive and negative charge amino acids in their structures (18, 64-67).

Perhaps may say that magainin is the first antiparsitic pepetide to destroy Paramecium Caudatum (19, 68). Cathelicidin is another peptide with ability of destroying Caernohabditis parasite, Other type of killing mechanism can involve direct desroying of cell membrane (20).

Control of microorganism is one of the most important issues of food preservation so that removing of pathogens commonly is targeted through most researches. Estimated that 6.5-30 million people infect by Food pathogens every year which damage 2.9-6.7 billion USD. Among them %25-55 of costs are due to gram positive bacteria. Regarding the possible resistance versus preservatives, and their incidence in nations, reminds necessity of resistant serotypes detection and inhibiting methods. Preservatives define as substances use in cosmetic, drug and food stuffs in order to protect them against bacteria, yeast, molds and extend their shelf life. Both chemical and natural preservatives are using, but the natural ones are more asked recently due to consumers' changing concepts about chemical preservatives because of being toxic or cancer creating properties. Natural preservatives come from microbes, animals and plants. A group of anti-microbial peptides produced by bacteria named bactericide like Nisin, pediocin etc with anti-bacterial activity used as preservative in foodstuffs. Nisin is one of the bactericide with anti-bacterial activity on gram positive bacteria. Nisin is polypeptide composed of 34 amino acids produced by LAB which introduced by Rogers first time in 1928 as a substance inhibiting Lactobacillus bulgaricus growth in industrial cheese. WHO announced Nisin as a preservative in 1969. Some Nisin properties include non-toxicity and good potential of storing, decomposable by digesting enzymes and no change in food flavors. Nisin creates holes in cytoplasmic membrane which causes to destruct cytoplasmic membrane and prevent vital ions gradient through membrane, leakage of ATP and amino acids. Nisin also prevents germination of spores and less affection on gram negative bacteria, molds and viruses. Nisin along with chemical naturals causes to reduce required preservative, sterilization temperature, reduction of thermal processing time, reduction of nutrient loss, and extending shelf life. Todays, Nisin applied in cured meat, alcoholic beverages, milk, cheese and so forth in more than 50 countries. Lactic acid bacteria's bacteriocins inhibit growth of pathogens and food spoiling bacteria.

Nicin which is one the conventional antibiotics is a peptide antibiotic (E 234) (21, 22) which produces by lactococcus lactis and activates versus a wide range of gram positive bacteria (23). Nisin is a heat and acid resistance bacterocine with anti-bacterial affection on gram positive bacteria including Licteria Monocytogenes, Staph aureus, amd prevent germination of clostridium and bacillus spores as well. Nisin's C temrnal connects to cytoplasmic membrane of germinating cells and create holes which allow outflow of Pottacium ions, ATP and amino acids (21). Commonly, Nisin is much more active in less pHs while temperature affections on its functionality is controversial (24). Nisin also effects on gram negative bacteria but less than gram positive ones and usually effective in combination of complex agents. Nisin is active in nano molar concentration with no toxic affections on human. Nisin interferes in Synthesizing of Cell wall. Bacteria membrane of B. subtilis partially perforates with no immediate death even vital activities of cell continues for 30 min after addition of Nisin . Gradually lengthening of bacteria causes to continuous of inhibitory cover and quick dividing causes to shortening cell. Abnormal morphology close to dividing zone depicts initial place of Nisin affection. Morphological changes are one of the proteins covering of string cells (MbI) and Min system is dividing inhibitory. Nisin biosynthesis includes modifications after synthesis of peptide substrate translation by ribosome which contains of unusual amino acids such as Lanthonin, dehydroalanin, dehydrobutyrin (23).

Nisin is positive charged peptide able to connect negative charged plasma membrane through electrostatic reaction. The mechanism of anti-bacterial activity of Nisin includes penetration ability to cytoplasmic membrane and interference to bacteria cell wall biosynthesis. Nisin targets lipid II substrate of cell wall & pyrophosphate endcaprynil, then penetrability of membrane is created after Nisin-lipid II complex forming. This reaction leads to create holes which lose electrostatic potential of membrane along with prevention of vital solution gradients (23). Shal et al studied inhibitory affection of Peptidoglycan during anti-microbial action of lanthonin in natural environment (25). Peptidoglycan is a dynamic system at which attaching of new peptidoglycan biosynthesis and decomposition through autolysis intensely as complementary of each other (23). The last stage of bacteria cell wall biosynthesis creates in out layer of membrane where biosynthesis interference is as the target of several cell wall inhibitory antibiotics.

CONCLUSION

Nisin causes to leak cytoplasmic content resulting in reduction of cross-section of bacteria. Forming of septum continues in presence of Nisin however many anomalies may observe. Cytokines occurs 30 min after adding Nisin which is in contrast with conventional concepts death cell occurring after addition of antibiotic. The main location of Nisin inhibitory is dividing area where peptidoglycan quickly forms. Nisin penetrates to plasma membrane, increases cell division and forms small cells, additionally setting out cell cover forming. Since Nisin lonely unable to prevent the growth of all microorganism and effects just on gram positive bacteria, it must be used with other preservatives.

REFERENCES

[1] Hotchkiss, R.D.; Dubos, R.J. Fractionation of the bactericidal agent from cultures of a soil *Bacillus*. *J. Biol. Chem.* 1940, *132*, 791–792.
[2] Dubos, R.J.; Hotchkiss, R.D. The production of bactericidal substances by aerobic sporulating bacilli. *J. Exp. Med.* 1941, *73*, 629–640.
[3] Conlon, J.M.; Sonnevend, A. Antimicrobial peptides in frog skin secretions. *Methods Mol. Biol.* 2010, *618*, 3– 14.
[4] Hancock, R.E.; Scott, M.G. The role of antimicrobial peptides in animal defenses. *Proc. Natl. Acad. Sci. USA* 2000, *97*, 8856–8861.
[5] Loppnow, H.; Libby, P.; Freudenberg, M.; Krauss, J.H.; Weckesser, J.; Mayer, H. Cytokine induction by

lipopolysaccharide (LPS) corresponds to lethal toxicity and is inhibited by nontoxic *Rhodobacter capsulatus* LPS. *Infect. Immun.* 1990, *58*, 3743–3750.
[6] Scott, M.G.; Rosenberger, C.M.; Gold, M.R.; Finlay, B.B.; Hancock, R.E. An alpha-helical cationic antimicrobial peptide selectively modulates macrophage responses to lipopolys
[7] Powers, J.P.; Hancock, R.E. The relationship between peptide structure and antibacterial activity. *Peptides* 2003, *24*, 1681–1691.
[8] Uteng, M.; Hauge, H.H.; Markwick, P.R.; Fimland, G.; Mantzilas, D.; Nissen-Meyer, J.; Muhle-Goll, C. Three- dimensional structure in lipid micelles of the pediocin-like antimicrobial peptide sakacin p and a sakacin p variant that is structurally stabilized by an inserted c-terminal disulfide bridge. *Biochemistry* 2003, *42*, 11417–11426.
[9] Hsu, C.H.; Chen, C.; Jou, M.L.; Lee, A.Y.; Lin, Y.C.; Yu, Y.P.; Huang, W.T.; Wu, S.H. Structural and DNA- binding studies on the bovine antimicrobial peptide, indolicidin: Evidence for multiple conformations involved in binding to membranes and DNA. *Nucleic Acids Res.*2005, *33*, 4053–4064.
[10] Pacor, S.; Giangaspero, A.; Bacac, M.; Sava, G.; Tossi, A. Analysis of the cytotoxicity of synthetic antimicrobial peptides on mouse leucocytes: Implications for systemic use. *J. Antimicrob.Chemother*. 2002, *50*, 339–348.
[11] Eckert, R.; Qi, F.; Yarbrough, D.K.; He, J.; Anderson, M.H.; Shi, W. Adding selectivity to antimicrobial peptides: Rational design of a multidomain peptide against *Pseudomonas* spp. *Antimicrob. Agents Chemother*. 2006, *50*, 1480–1488.
[12] Tamamura, H.; Ishihara, T.; Otaka, A.; Murakami, T.; Ibuka, T.; Waki, M.; Matsumoto, A.; Yamamoto, N.; Fujii, N. Analysis of the interaction of an anti-hiv peptide, t22 ([tyr5, 12, lys7]- polyphemusin ii), with gp120 and cd4 by surface plasmon resonance. *Biochim. Biophys. Acta* 1996, *1298*, 37–44.
[13] Liu, Y.; Gong, W.; Huang, C.C.; Herr, W.; Cheng, X. Crystal structure of the conserved core of the herpes simplex virus transcriptional regulatory protein vp16. *Genes Dev.* 1999, *13*, 1692–1703.
[14] Shai, Y. Mode of action of membrane active antimicrobial peptides. *Biopolymers* 2002, *66*, 236–248.
[15] Brogden, K.A. Antimicrobial peptides: Pore formers or metabolic inhibitors in bacteria? *Nat. Rev. Microbiol.* 2005, *3*, 238–250.
[16] Van der Weerden, N.L.; Hancock, R.E.; Anderson, M.A. Permeabilization of fungal hyphae by the plant defensin nad1 occurs through a cell wall-dependent process. *J. Biol. Chem.* 2010, *285*, 37513–37520.
[17] Moerman, L.; Bosteels, S.; Noppe, W.; Willems, J.; Clynen, E.; Schoofs, L.; Thevissen, K.; Tytgat, J.; Van Eldere, J.; van der Walt, J.; *et al*. Antibacterial and antifungal properties of α-helical, cationic peptides in the venom of scorpions from southern Africa. *Eur. J. Biochem.* 2002, *269*, 4799–4810.
[18] Jenssen, H.; Hamill, P.; Hancock, R.E.W. Peptide antimicrobial agents. *Clin. Microbiol. Rev.* 2006, *19*, 491– 511.
[19] Zasloff, M. Magainins, a class of antimicrobial peptides from *Xenopus* skin: Isolation, characterization of two active forms, and partial cDNA sequence of a precursor. *Proc. Natl.Acad. Sci. USA* 1987, *84*, 5449–5453.
[20] Park, Y.; Jang, S.H.; Lee, D.G.; Hahm, K.S. Antinematodal effect of antimicrobial peptide, pmap-23, isolated from porcine myeloid against *Caenorhabditis elegans*. *J. Pept. Sci.* 2004, *10*, 304–311.
[21] Abee T, Rombouts FM, Hugenholtz J, Guihard G, Letellier L (1994) *Appl Environ Microbiol* 60:1962–1968.
[22] Delves-Broughton J (1990) *Food Technol* 44:100–117.
[23]Alexander J. Hyde, Judicae l Parisot, Adam McNichol, Boyan B. Bonev (2006) *National Academy of Sciences*103 (52): 19896–19901.
[24] Paula M. Periago, Roy Moezelaar (2001) International Journal of Food Microbiology 62:141–148.
[25] Bonelli RR, Schneider T, Sahl H-G, Wiedemann I (2006) Antimicrob Agents Chemother 50:1449–1457.
[26] Asadizaker M, Abedsaeedi Z, Abedi H, Alijanirenani H, Moradi M, Jahani S. Improvement of the First Training for Baccalaureate Nursing Students--A Mutual Approach. Glob J Health Sci. 2015 Mar 26;7(7 Spec No):79-92. doi: 10.5539/gjhs.v7n7p79.
[27] Darvishi M, Nazer MR, Alipour MR. Investigating the end of patients suffering from diabetic foot hospitalized in Be'sat hospital of IRIAF from 2009 to 2014. (2017) Biomedical Research (India), 28 (10), pp. 4360-4633.
[28] Damshenas MH, Kalani N. Determining retelling of events during general anesthesia in open-heart surgery patients in the hospitals affiliated to shiraz university of medical sciences. IIOAB Journal. Volume 7, October 2016, Pages 329-332.
[29] Darvishi M, Ziari K, Mohebbi H, Alizadeh K. Association between iron deficiency anemia and Helicobacter pylori infection among children under six years in Iran. Acta Med Iran. 2015;53(4):220-4.
[30] Darvishi M. Virulence factors profile and antimicrobial resistance of acinetobacter baumannii strains isolated from various infections recovered from immunosuppressive patients. (2016) Biomedical and Pharmacology Journal, 9 (3), pp. 1057-1062.
[31] Tavan H, Sayehmiri K, Taghinejad H, Mousavi Moghadam SR. Factor Analysis of Spiritual Health on the Islam Viewpoint. Iran J Public Health. 2015 Nov;44(11):1572-3.
[32] Heidari Gorji MA, Rezaei F, Jafari H, Yazdani Cherati J. Comparison of the effects of heparin and 0.9% sodium chloride solutions in maintenance of patency of central venous catheters. Anesth Pain Med. 2015 Mar 30;5(2):e22595. doi: 10.5812/aapm.22595. eCollection 2015 Apr.
[33] Taheri L, Boroujeni AZ, Kargar Jahromi M, Charkhandaz M, Hojat M. Effect of streptokinase on reperfusion after acute myocardial infarction and its complications: an ex-post facto study. Glob J Health Sci. 2015 Jan 1;7(4):184-9. doi: 10.5539/gjhs.v7n4p184.
[34] Younesi, E, Bayati V, Hashemitabar M, Azandeh SS, Bijannejad D, Bahreini A. Differentiation of adipose-derived stem cells into schwann-like cells: Fetal bovine serum or human serum?. Anatomy and Cell Biology.2015. 48(3), pp. 170-176.
[35] Khodadi E, Shahrabi S, Shahjahani M, Azandeh S, Saki N. Role of stem cell factor in the placental niche. Cell and Tissue Research.2016. 366(3), pp. 523-531.
[36] Saeedi E, Nasiri Toosi M, Salehi M, Khosravi Bizhaem S, Abolghasemi J. Effective factors for risk of death in patients with cirrhosis using competing risks model. Govaresh. 2016. 21(1), pp. 27-34
[37] Asgary MR, Hemmati H. A study on benign breast disease. Der Pharmacia Lettre. 2016. 8(20), pp. 137-139.
[38] Assareh M , Moghaddam M F , Rakhshani T , Nikoo M A , Effatpanah M , Rai A , Rezaie L. The motives behind the decision for choosing self-immolation as a method for suicide. 2013. Life Science Journal. 10(4), pp. 1610-1614.
[39] Semnani S, Roshandel G., Abdolahi N, Besharat S, Keshtkar AA, Joshaqani H, Danesh A. HBV/HCV co-infection in Iran: A seroepidemiological based study. 2006. Pakistan Journal of Biological Sciences. 9(13), pp. 2538-2540.

[40] Aghamohammadzadeh N, Aliasgarzadeh A, Baglar L, Abdollahifard S, Bahrami A, Najafipour F, Niafar M. Comparison of metformin and cyproteroneestrodiol compound effect on hs c-reactive protein and serum androgen levels in patients with poly cystic ovary syndrome. 2010. Pakistan Journal of Medical Sciences. 26(2), pp. 347-351.
[41] Moghadam MYA, Moradian M, Givtaj N, Mozaffari K. Intraluminal ascending aorta fibroma. 2011. Journal of Tehran University Heart Center. 6(1), pp. 45-47
[42] Moradian M, Shahmohammadi A, Yoosefnia MA, Mozaffari K. One and a half ventricular repair for Uhl's anomaly with one year follow up. 2011. Iranian Cardiovascular Research Journal. 5(1), pp. 35-38
[43] Shushizadeh MR, Mostoufi A, Fakhrian M. Marine sponge/cuo nanocrystal: A natural and efficient catalyst for sulfonamides synthesis. 2012. Jundishapur Journal of Natural Pharmaceutical Products. 7(4), pp. 134-139.
[44] Taymoori P, Moshki M, Roshani D. Facilitator psychological constructs for mammography screening among iranian women. Asian Pacific Journal of Cancer Prevention. 2014. 15(17), pp. 7309-7316
[45] Macooie AA, Pashapoor N, Yekta Z, Karamyar M. Serum prolactin level after febrile seizure versus epileptic seizure in 6-month-old to 5-year-old children. Iranian Journal of Medical Sciences. 2009. 34(3), pp. 177-180.
[46] Nazer MR, Ghanadi K, Goodarzi G, Sajedi Y, PourniaY, Darvishi M. Prevalence of Chlamydia pneumoniae by Real time PCR in referred patients with respiratory syndrome to clinic center of infectious diseases. Life Science Journal. Volume 11, Issue 1 SPECL. ISSUE, 2014, Article number 15, Pages 87-92.
[47] Nazer MR, Ghanadi K, Goodarzi G, Sajedi Y, PourniaY, Darvishi M. Prevalence of Chlamydia pneumoniae by Real time PCR in referred patients with respiratory syndrome to clinic center of infectious diseases. Life Science Journal. Volume 11, Issue 1 SPECL. ISSUE, 2014, Article number 15, Pages 87-92.
[48] Samadian M, Alavi E, Sharifi G, Rezaee O, Faramarzi F. Extension of Echinococcal spinal infestation extra- and intradurally after a decade of extinction. Journal of Neurosurgical Sciences. . 2010 54(4), pp. 143-148.
[49] Badri R, Shushizadeh MR. Silica sulfuric acid as an efficient reagent for bamberger rearrangement of phenyl hydroxylamine derivatives in solvent-free conditions. Asian Journal of Chemistry. . 2007 19(6), pp. 4661-4664.
[50] Asgary MR, Hemmati H. A study on benign breast disease. Der Pharmacia Lettre. 2016. 8(20), pp. 137-139.
[51] Alinejad V, Mahmodi M, Alinejad M, Besharat E, Gholizade R, Tabbakhi E, Shojaei Pour A, Gharaaghaji R. Investigation of long- and short-term relationships between cesarean delivery and its effective factors in Malayer. Global journal of health science. 2014. 6(7), pp. 1-7
[52] Lubin AS, Snydman DR, Ruthazer R, Bide P, Golan Y. Predicting high vancomycin minimum inhibitory concentration in methicillin-resistant Staphylococcus aureus bloodstream infections. Clin Infect Dis. 2011 Apr 15;52(8):997-1002. doi: 10.1093/cid/cir118.
[53] Salari MH, Sohrabi N, Kadkhoda Z, Khalili MB. Antibacterial effects of enoxolone on periodontopathogenic and capnophilic bacteria isolated from specimens of periodontitis patients. Iranian Biomedical Journal. 2013. 7(1), pp. 39-42
[54] Badri R, Shushizadeh MR A new method for the oxybromination of aromatic compounds with copper(II)bromide and potassium dichromate. 2005. Phosphorus, Sulfur and Silicon and the Related Elements. 180(2), pp. 533-536.
[55] Badri R, Shushizadeh MR. An efficient tandem oxidative-protection reaction of benzylic alcohols to corresponding arylhydrazones and oximes. 2007. Phosphorus, Sulfur and Silicon and the Related Elements. 182(3), pp. 601-60
[56] Valizadeh R, Taymoori P, Yousefi F, Rahimi L, Ghaderi N. The effect of puberty health education based on health belief model on health behaviors and preventive among teen boys in Marivan, North West of Iran. International Journal of Pediatrics. 2016. 4(8), pp. 3271-3281
[57] Farhidnia N, Memarian A. Congenital anomalies following use of isotretinoin: Emphasis on its legal aspects. Med Leg J. 2017 Mar;85(1):33-34. doi: 10.1177/0025817216668720. Epub 2016 Sep 25.
[58] Mehrpisheh S, Mosayebi Z, Memarian A, Kadivar M, Nariman S, Ostadrahimi P, Dalili H. Evaluation of specificity and sensitivity of gastric
[59] aspirate shake test to predict surfactant deficiency in Iranian premature infants. Pregnancy Hypertens. 2015 Apr;5(2):182-6. doi: 10.1016/j.preghy.2015.01.006. Epub 2015 Feb 21.
[60] Ameri M, Memarian A, Behtash N, Karimi Zarchi M. The importance of re-examination with deep biopsies in diagnosing cervical malignancies despite multiple negative pathology reports: A case report. Int J Surg Case Rep. 2015;14:48-9. doi: 10.1016/j.ijscr.2015.07.010. Epub 2015 Jul 21.
[61] Memarian A, Ameri E, Aghakhani K, Mehrpisheh S, Ameri M. The epidemiology of lower extremities injuries in Iranian population. Iran J Public Health. 2016 Jul;45(7):960-1.
[62] Kazemi S, Khayati G, Faezi-Ghasemi M. β-galactosidase production by Aspergillus niger ATCC 9142 using inexpensive substrates in solid-state fermentation: Optimization by orthogonal arrays design. Iranian Biomedical Journal. 2016. 20(5), pp. 287-294
[63] Rastegarian A, Jahromi MJ, Sanie MS, Kalani N. Comparing the anxiety of children when entering and leaving the operating room with and without the presence of parents. Journal of Global Pharma Technology.2016. 8(6), pp. 42-46
[64] Darvishi M. Antibiotic resistance pattern of uropathogenic methicillin-resistant staphylococcus aureus isolated from immunosuppressive patients with pyelonephritis. (2016) Journal of Pure and Applied Microbiology, 10 (4), pp. 2663-2667.
[65] Sotoudeh A, Jahanshahi A, Zareiy S, Darvishi M, Roodbari N, Bazzazan A. The influence of low-level laser irradiation on spinal cord injuries following ischemia-reperfusion in rats. Acta Cir Bras. 2015 Sep;30(9):611-6.
[66] Rashidpanah M, Abolghasemi J, Toosi MN, Salehi M. Investigating the different stages in the progress of cirrhosis using the Markov model. Govaresh. 2016. 21(3), pp. 157-166
[67] Taymoori P, Molina Y, Roshani D. Effects of a randomized controlled trial to increase repeat mammography screening in Iranian women. Cancer Nursing. 2015. 38(4), pp. 289-297
[68] Behnam Soboti , Shima Javadinia , Samileh Noorbaksh , Ramin Asgarian , Nastaran Khosravi , Azardokht Tabatabaee . Diagnostic value of the level of interleukins in cerebrospinal fluid in children meningitis. Tehran Univ Med J 2015, 72(12): 847-853.
[69] Poorgholami F, Mansoori P, Montaseri Z, Najafi K. Effect of self care education with and without telephone follow-up on the level of hope in renal dialysis patients: A single-blind randomized controlled clinical trial. International Journal of Community Based Nursing and Midwifery. 2016. 4(3), pp. 256-264.