Bionatura
Latin American Journal of Biotechnology and Life Sciences

Bionatura Issue 1 Vol 8 No 1 2023

Article

Estimation of some biochemical changes as risk factors in prostate cancer

Muthaffar S. AL-Kirikchi[1,], and Huda Y. AL-Attar[1]*
[1] College of Science, University of Mosul, Iraq
** Correspondence: muthaffarmsa@gmail.com*
Available from: http://dx.doi.org/10.21931/rb/ 2023.08.01.40

ABSTRACT

This study was conducted to evaluate some indicators that increase the risk of developing prostate cancer. The current study included the parameters of PSA, vitamin D, phosphorous, and calcium in the blood serum with several (191) samples: (90) samples belonged to prostate cancer patients, (43) samples were from men with benign prostatic hyperplasia (BPH), and (58) samples were from healthy men as a control group. Samples were collected from patients attending the Specialized Nuclear Medicine and Oncology Hospital in Mosul depending on PSA test levels and from information documented in patient data. The results show a significant ($P \leq 0.01$) increase in PSA level in the prostate cancer group compared with benign prostatic hyperplasia (BPH), and the control group also showed a significant ($P \leq 0.01$) increase in PSA level in the BPH group compared with the control group, while no significant ($P \leq 0.01$) difference in all tumor stages. The current study showed a significant ($P \leq 0.01$) decrease in the levels of vitamin D in the blood serum of the prostate cancer group compared to the benign prostatic hyperplasia group and the control group. There was also a significant ($P \leq 0.01$) decrease in vitamin D levels among the patients with benign prostate hyperplasia group and control group. In contrast, there was no significant (P 0.01) differences in vitamin D levels across all tumor stages. The results showed a significant increase ($P \leq 0.01$) in the levels of serum calcium in the patients with prostate cancer compared with the benign prostate hyperplasia group and control group and a significant increase ($P \leq 0.01$) in patients with the benign prostate hyperplasia group compared with the controls groups. At the same time, the results revealed no significant difference in calcium levels across all tumor stages. The results showed a significant ($P \leq 0.01$) increase in the phosphorus levels in patients with prostate cancer compared with the benign prostate hyperplasia group and control groups and a significant ($P \leq 0.01$) increase in the patients with benign prostate hyperplasia group compared with control groups. In contrast, the result showed no significant difference in phosphorus levels between all stages of the tumor.

Keywords: PSA, Phosphorus, Prostate cancer, Benign prostate hyperplasia (BPH), Vitamin D, Calcium.

INTRODUCTION

The prostate gland is one of the most important glands in the male reproductive system. It performs a primary function, which is the secretion of prostate fluid, which works to support and nourish the sperm during the fertilization process. The prostate exhibits a metabolic process adapted to produce prostate fluid, consisting of zinc, cholesterol, and the enzymes citrate and kallikrein: Coordination of various physical functions: blood pressure, semen liquefaction and skin desquamation [1, 2]. Many diseases, such as some cancers, can be diagnosed using some "biomarkers," such as estimations of certain hormones, proteins, or mutations in certain genes. These molecules reverse abnormal processes in the affected organs, as these biomarkers help diagnose and determine treatment options for the disease [3].

Prostate gland cancer is one of the most common types of malignancy of the male reproductive system worldwide, as well as being one of the leading causes of cancer-related death in men. [4].

Benign prostatic hyperplasia is a pathological condition that increases the number of prostatic stromal cells and prostatic epithelial cells in the transitional zone of the prostate [5].

In the past few decades, measurement of the concentration of prostate-specific antigens (PSA) has been adopted as an effective marker for diagnosing prostate cancer and for following up on disease progression in conjunction with other examinations . [6, 7]. There are two forms of vitamin D, ergocalciferol (vitamin D2) and cholecalciferol (vitamin D3), that are produced endogenously in the dermis in response to the sun's ultraviolet rays and are derived from the compound 7-dehydrocholesterol. External sources of vitamin D include eggs, dairy products, vitamin D-containing nutritional supplements, and fish [8].

Phosphorus is an essential element in the human body. Organophosphorus is mainly present in high-energy phosphate compounds, phospholipids, and nucleic acids [9]. Phosphorus is a mineral that makes up about 1% of the body's mass and is necessary for cell functions. It contributes to creating and storing energy in the molecular form of adenosine triphosphate, the main ingredient of bones and teeth. [10].

Calcium is a very important element in the human body, and the regulation of calcium in the body is of great importance, as it plays a vital role in many physiological processes within the body, such as cell division, muscle contraction, apoptosis, metabolism processes, phagocytosis, and cellular signaling [11, 12]. The disease occurs when there is an imbalance in the regulatory factors for calcium homeostasis, such as osteoporosis or hypercalcemia [13].

MATERIALS AND METHODS

In the current study, 191 blood samples were collected from men: (90) samples from men diagnosed with prostate cancer, (43) samples from men with benign prostatic hyperplasia, and (58) samples from healthy men in the Oncology and Nuclear Medicine Specialized Hospital in Mosul. All samples were divided into 4 age groups: 45 - 55, 56 - 65, 66 - 75, and 76 - 85 years. The prostate cancer group is divided into four stages according to the stages of the disease. Blood samples were collected in the morning for all men who had fasted for at least 14 hours in 5 ml tubes, and blood serum was obtained accordingly [14]. The statistical analysis of this study was carried out using the t-value test [15].

In the current study, blood serum was used to estimate the levels of some of the biochemical variables under study:

Biochemical Tests

PSA & Vitamin D

PSA and Vitamin D concentrations in serum were estimated by using the Minividas Kit provided by BioMérieux - France [16, 17].

Phosphorus and Calcium concentrations in serum were estimated using the Biolabo-France Kit [18, 19]. [20].

DISCUSSION

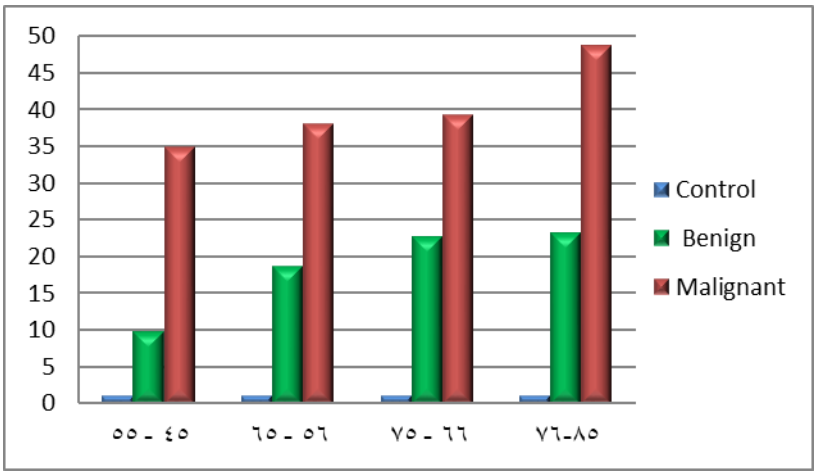

Figure 1. PSA concentration in all age groups

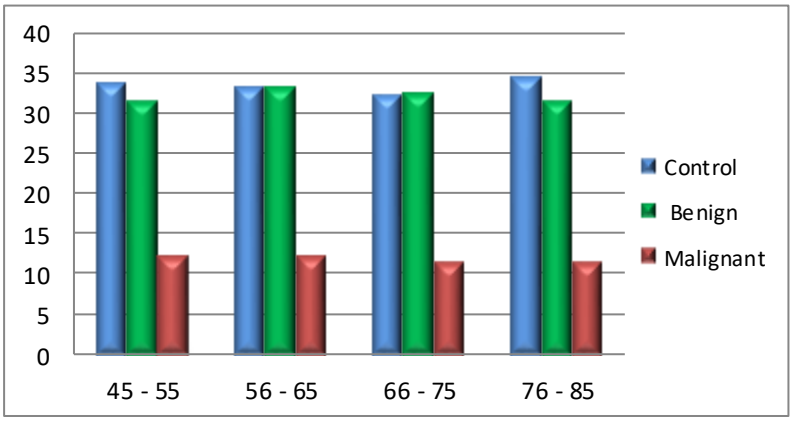

Figure 2. Vitamin D3 concentration in all age groups

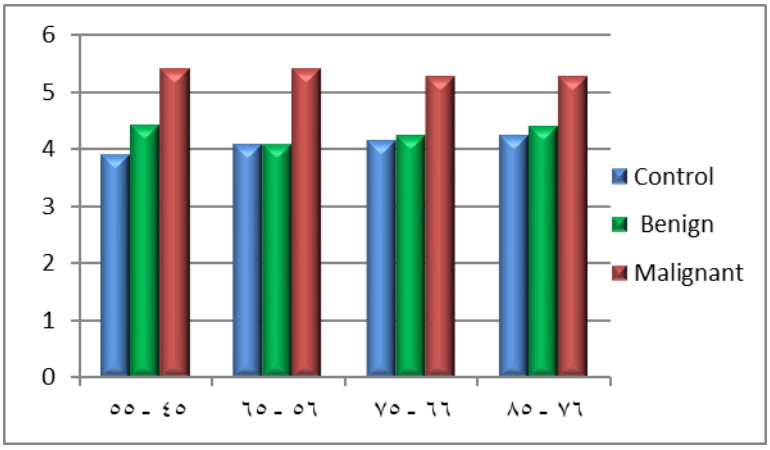

Figure 3. Phosphorus concentration in all age groups

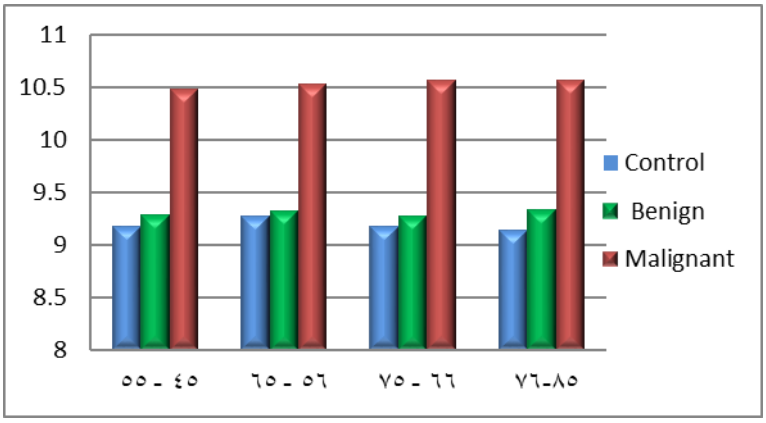

Figure 4. Calcium concentration in all age groups

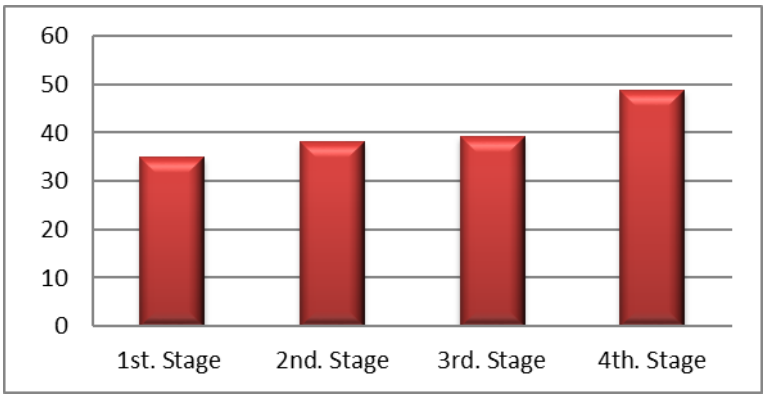

Figure 5. PSA concentrations at each stage

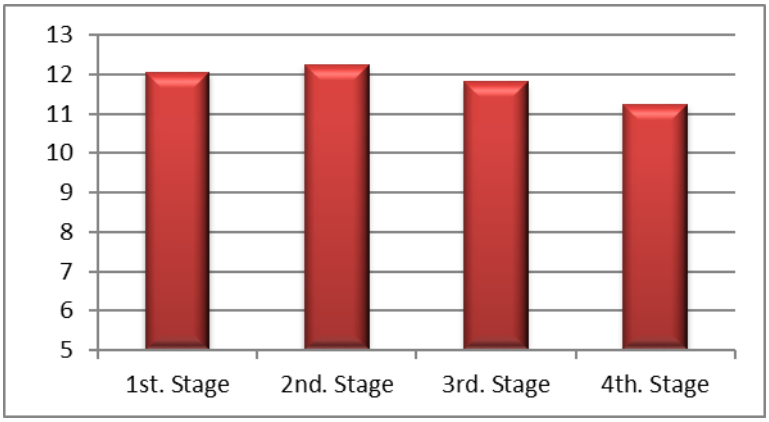

Figure 6. Vitamin D3 concentrations at each stage

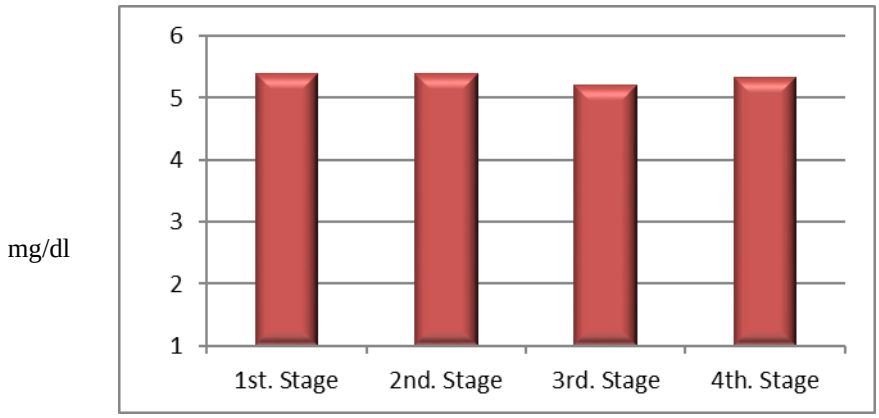

Figure 7. Phosphorus concentrations at each stage

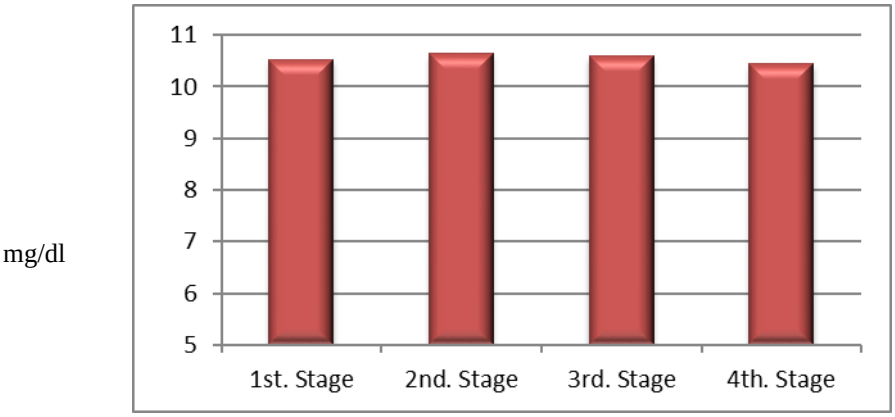

Figure 8. Calcium concentrations at each stage

Figure 1 showed a significant increase ($P \leq 0.01$) in PSA levels in the prostate cancer group compared with the (BPH) and control groups, which also showed a significant increase ($P \leq 0.01$) in PSA levels in the (BPH) group compared with the control group. Whereas figure 5 showed no significant difference in the stages group. The PSA test is considered one of the most widely used vital markers to diagnose prostate cancer, as it is used in all stages of prostate cancer detection, monitoring patients after diagnosis, patients' response to treatment, and recurrence after treatment [21, 22].

Figure 2 showed a significant decrease ($P \leq 0.01$) in vitamin D concentration in the prostate cancer group compared with other groups and a significant decrease ($P \leq 0.01$) in vitamin D in the BPH group compared with the control group. This is consistent with a study by [23], whereas there was no significant difference in the stages of the cancer group in Figure 6. One study on the relationship of vitamin D with prostate cancer indicated that an increase of 20 nmol/L of vitamin D in plasma measured in patients with prostate cancer before and after diagnosis reduced the overall prostate cancer death rate by 9% [24]. The presence of calcitriol in the blood regulates cell growth and differentiation, as well as the invasion and maturation of tumors and its participation in the suppression of cancer in the body. Thus, it is assumed that a high percentage of vitamin D prevents many types of cancer [25].

Figure 3 showed a significant increase ($P \leq 0.01$) in phosphorus levels in the prostate cancer group compared with the (BPH) and control groups and showed a

significant increase in (BPH) group compared with the control group. In contrast, Figure 7 showed no significant difference between all stages of cancer. These elevated intracellular levels of phosphorous increase ribosomal RNA biosynthesis, resulting in increased synthesis of a protein that supports tumor growth [26].

Studies have indicated that low vitamin D levels are associated with cancer and tumors with high levels of irregular phosphate in the body. It is thought that hyperphosphatemia may be a mediating factor linking low vitamin D levels in blood serum and an increased risk of cancer. [27].

Figure 4 revealed a significant ($P \leq 0.01$) increase in calcium levels in the prostate cancer group when compared to the (BPH) and control groups. In contrast, Figure 8 revealed no significant ($P \leq 0.01$) difference in calcium levels in all stages of cancer. Calcium homeostasis occurs regularly, but this regulation can be disturbed by many benign or malignant processes. This imbalance may occur in patients with cancer. Hypercalcemia in the blood serum resulting from malignancy occurs due to the protein production associated with parathyroid hormone. Thus, increasing calcium uptake from bone or producing cytokines that activate osteoclast degradation [28]. Mutations in cancer cells lead to changes in expression that affect the function of calcium channels, pumps, and bound proteins, which lead to an increase in calcium levels to the maximum level compared to normal cells. These high calcium levels allow cells to multiply and turn into malignant tumors [29].

CONCLUSION

An increase in phosphorous levels in the blood, like hyperphosphatemia, activates the endocrine feedback mechanism, which reduces the biologically active vitamin D and reduces phosphate absorption from the intestine. Moreover, when there is an excessive increase in phosphate levels in the blood, there will be an increase in the levels of inorganic phosphate in the tumor through the sodium phosphate transporters in the cells.

References

1 Uo, T.; Sprenger, C.C.; Plymate, S.R. Androgen Receptor Signaling and Metabolic and Cellular Plasticity during Progression toCastration Resistant Prostate Cancer. *Front. Oncol*. **2020**, *10*, 2275.

2 Costello, L.C.; Franklin, R.B. A Comprehensive Review of the Role of Zinc in Normal Prostate Function and Metabolism; and Its Implications in Prostate Cancer. Arch. Biochem. *Biophys*. **2016**, *611*, 100–112.

3 Louis, M. A., Ouellet, V., Péant, B., Caron, C., Li, Z., Al-Mass, A., ... & Saad, F. Elevated Expression of Glycerol-3-Phosphate Phosphatase as a Biomarker of Poor Prognosis and Aggressive Prostate Cancer. *Cancers*, **2021**; *13(6)*, 1273.

4 Montironi, R.; Cimadamore, A.; Lopez-Beltran, A.; Cheng, L.; Scarpelli, M. Update on prostate cancer diagnosis, prognosis, and prediction to response to therapy. *Cells* **2020**, *10*, 20.

5 Mahon JT, McVary KT. New alternative treatments for lower urinary tract symptoms secondary to benign prostatic hyperplasia. In: Minimally Invasive Urology: An Essential Clinical Guide to Endourology, Laparoscopy, LESS and Robotics, 2nd ed, Best SL, Nakada SY (Eds), Springer, Cham, Switzerland **2020**. p.283.

6 Cooperberg MR, Brooks JD, Faino AV, Newcomb LF, Kearns JT, Carroll PR, et al. Refined Analysis of Prostate-Specific Antigen Kinetics to Predict Prostate Cancer Active Surveillance Outcomes. *Eur Urol*.**2018**;*74*:211–7.

7 Mahal BA, Yang DD, Wang NQ, Alshalalfa M, Davicioni E, Choeurng V, et al. Clinical and Genomic Characterization of Low–Prostate-specific Antigen, High-grade Prostate Cancer. *Eur Urol.* **2018**;*74*:146–54.

8 Zabetakis, I.; Lordan, R.; Norton, C.; Tsoupras, A. COVID-19: The inflammation link and the role of nutrition in potential mitigation. *Nutrients* **2020**, *12*, 1466.

9 Michigami, T., Kawai, M., Yamazaki, M., and Ozono, K. Phosphate as a Signaling molecule and its sensing mechanism. Physiol. Rev. 98, 2317–2348. doi: 10.1152/physrev.00022.2017. **2018**.

10 Calvo, M.S.; Lamberg-Allardt, C.J. Phosphorus. Adv. *Nutr*. **2015**, *6*, 860–862.

11 Terrié, E.; Coronas, V.; Constantin, B. Role of the calcium toolkit in cancer stem cells. *Cell Calcium* **2019**, *80*, 141–151.

12 Weaver, C.M.; Peacock, M. Calcium. Adv. *Nutr*. **2019**, *10*, 546–548.

13 Yan, D.; Xu, Y.; Li, L.-X. The coexistence of hypercalcemia, osteoporosis and thymic enlargement in graves' disease: A case report.BMC Endocr. *Disord*. **2020**, *20*, 97..

14 Tietz, N.W. "Text Book of Clinical Chemistry". 2nd ed., Saunders Company, U.S.A., **1994;** PP. 13211-6.

15 Hinton, P." Statistics Explained ". 2nd ed. By Routledge. Printed in the USA and Canada. **2004**. pp. 85-125.

16 Christenson A, Laurell C-B, Lilija H. Enzymatic activity of Prostate-specific Antigen and its reactions with extracellular Serine Proteinase inhibitor. *Eur J Biochem* **1990**; *194*: 755-63.

17 Holick MF. Vitamin D status: measurement, interpretation, and clinical application. *Ann Epidemiol*. **2009** Feb;*19(2):*73-8.

18 Daly J. A. and Ertingshausen G.,Clin. Chem., *Direct method for inorganic phosphate determination*, **1972**, *18*, p.263-265.

19 Gamst O.K., Try K, Sc and. *J. Clin. Lab. Invest*. **1980**, *40*, p.483-486.

20 Moorehead W.R., *Briggs H. G., Clin. Chem*., **1974**, *20*, p. 1458-1460.

21 Pinsky PF, Prorok PC, Kramer BS. Prostate cancer screening - a perspective on the current state of the evidence. *N Engl J Med* **2017**;*376*:1285-9.

22 Loblaw, A., Souter, L. H., Canil, C., Breau, R. H., Haider, M., Jamnicky, L., ... & Matthew, A. Follow-up care for survivors of prostate cancer–clinical management: a program in evidence-based care systematic review and clinical practice guideline. *Clinical Oncology*, **2017**;*29(11)*, 711-717.

23 Amadi, C., Orluwene, C., & Amadi, B. Serum Vitamin D Level Status by Prostate Cancer Grade and Stage Among Native Africans. *American Journal of Laboratory Medicine*, **2022**; *7(1)*, 6-15.

24 Song ZY, Yao Q, Zhuo Z, et al. Circulating vitamin D level and mortality in prostate cancer patients: a dose–response meta-analysis.*Endocr Connect.* **2018**;*7*:R294–303.

25 Uhmann, A., Niemann, H., Lammering, B., Henkel, C., Hess, I., Nitzki, F.,Fritsch, A., Prüfer, N., Rosenberger, A., Dullin, C., Schraepler, A., Reifenberger,J., Schweyer, S., Pietsch, T., Strutz, F., Schulz-Schaeffer, W., & Hahn, H. Antitumoral effects of calcitriol in basal cell carcinomas involve inhibition of hedgehog signaling and induction of vitamin D receptor signaling and differentiation.*Molecular Cancer Therapeutics*, **2011**;*10 (11)*, 2179–2188.

26 Brown, R. B. Potential interaction of inflammatory hyperemia and hyperphosphatemia in tumorigenesis. *Future Oncology*, **2019a**; *15(34)*, 3909-3916.

27 Brown, R. B. Vitamin D, cancer, and dysregulated phosphate metabolism. *Endocrine*, **2019b**; *65(2)*, 238-243.

28 Zagzag, J., Hu, M. I., Fisher, S. B., & Perrier, N. D. Hypercalcemia and cancer: Differential diagnosis and treatment. CA: *a cancer journal for clinicians*, **2018**; *68(5)*, 377-386.

29 Stewart, T.; Yapa, K.T.; Monteith, G.R. Altered calcium signaling in cancer cells. Biochim. Biophys. *Acta (BBA) Biomembr*. **2015**, *1848*, 2502–2511.

30 Anter, S.H. and AL-Wakaa, A.H. Statistical Analysis For Agricultural Experiments Using SAS program. Ministry of Higher Education and Scientific Research. Diyala University, College of Agriculture. **2017**.

Received: May 15, 2023/ Accepted: June 10, 2023 / Published: June 15, 2023

Citation: AL-Kirikchi, M.S.; AL-Attar, H.Y. Estimation of some biochemical changes as risk factors in prostate cancer. Revis Bionatura 2023;8 (2) 90. http://dx.doi.org/10.21931/RB/ 2023.08.01.40