Cholesterol Reduction by Probiotic Bacteria *Lactobacillus Plantarum* From Cow's Milk

Mohamed Abdel-Razik[1], Mohamed Farouk Ghaly[2], and Samar Mohamed[1*]

[1]Department of Botany and Microbiology, Faculty of science, Suez Canal University, Egypt.

[2]Department of Botany and Microbiology, Faculty of science, Zagazig University, Egypt

*** Correspondence:** Samar Mohamed Mahmoud, Department of Botany and Microbiology, Faculty of science, Suez Canal University, 4.5 Km the Ring Road, Ismailia Government, 41522, Egypt.
Email: samar.mohmed22@yahoo.com. Mobile: +201090056949

Abstract:
This study aims to study was to insulate and investigate the impact of some probiotic bacteria from different sources of milk and milk products in the reduction of cholesterol. Out of fourteen tested bacterial isolates, isolate no. (LAB 8) from raw cow's milk was the most potent isolate that reduced cholesterol by 33.07%. The cholesterol reduction potentiality by the isolate no (LAB 8) was optimized to 53.3% by studying and controlling the different cultural conditions as incubation temperatures, incubation periods, pH, cholesterol concentrations, carbon sources, nitrogen sources, phosphorus sources and UV radiation exposure. The highest ratio of cholesterol reduction by isolate no (LAB 8) was obtained after 6 days of incubation at 37ºC in basal medium of cholesterol well-adjusted to pH 7, with addition of cholesterol (0.75 g/L) as a substrate, maltose (1.0 g/100 mL) and after exposure to UV radiation for 60 min. The selected bacterial isolate no. (LAB 8) was identified biochemically by VITEK®2 as *Lactobacillus plantarum*.

Key words: Cholesterol, *Lactobacillus plantarum*, VITEK®2, UV radiation

Introduction:

Cholesterol is the most vital lipid present in all human cells, responsible for the structure of cellular membranes and sterols ***(Palani et al., 2021)***. The most of

cholesterol mainly produces in liver ***(Yehia et al., 2015)***. Cholesterol is essential for sex hormones synthesis ***(Young, 2001)***, also it is been transformed into vitamin D in the kidney and skin and into bile acids in the liver that aid in fat digestion ***(Russell, 2003)***. A high level of cholesterol poses a risk for cardiovascular diseases, as the fat accumulation in the blood vessels impairs the blood supply to the organs. Several laboratories, clinical and epidemiological studies have found a correlation between hypercholesterolemia and an increased risk of cardiovascular disease, a notable cause of death in western countries ***(Palani et al., 2021)***. The World Health Organization (WHO) describes probiotics as living microorganisms that, when provided in appropriate quantities, contribute a health benefit to the host ***(WHO, 2002)***. In the 1970s, it was discovered that fermented milk containing *Lactobacillus* strain had a hypocholesterolemia effect in humans ***(Mann and Spoerry, 1974)***. *Invitro* or *invivo* studies have been designed to examine the cholesterol-lowering. Since then, several effects of lactic acid bacteria (LAB), especially *Lactobacillus* and *Bifidobacterium* strains have been observed by ***Pan et al. (2011); Wang et al. (2012)****;and* ***Pereira and Gibson (2002)*** concluded a review from investigations on the hypocholesterolemic impact of probiotics in which, the fermentation of dairy products with the applicable bacteria strain can lower the concentrations of blood cholesterol and these strains do not usually exist in the intestine of human. Consumption of probiotic products on a daily basis can be a dietary resolution for achieving the long hypocholesterolemic effects ***(Tsai et al, 2014)***. Several studies have shown that different bacteria can lower cholesterol levels in aqueous systems like liquid media ***(Saavedra et al., 2004)*** and blood serum ***(Hlivak et al., 2005).***

This current work was proposed to evaluate the dietary treatment role of some probiotic's bacteria in lowering cholesterol.

Materials and Methods:

1. The isolation of cholesterol reducing probiotic bacteria:

Fifteen samples of milk and milk product were collected from different domestic markets and farmers in Zagazig City, Egypt, through February to May 2019. The samples were suspended by shaking 10 g of each sample for 20 minutes in 90 ml of sterile saline solution (8.5 g NaCl/L), then 0.1 mL of each suspension was spread on the surface of plates containing MRS agar media

(de Man, Rogosa, Sharpe, Oxoid) for isolation of lactic acid bacteria under aseptic conditions and incubated for 2 days at 37ºC.

2. Screening of bacterial isolates growth on cholesterol agar plate:

The pure bacterial isolates were streaked on the surface of plates containing Minimal Salt Cholesterol (MSC) agar media, supplemented with cholesterol (0.2%) as a sole carbon source ***(Nishiya et al., 1997).*** The media including (g/L): NH_4NO_3, 17; K_2HPO_4, 0.25; $MgSO_4.7H_2O$, 0.25; $FeSO_4.H_2O$, 0.001; NaCl, 0.05; cholesterol, 1.5; agar 20 and Tween 80 (0.1 mL/L). To avoid the cholesterol coagulation, firstly it was suspended in 10 mL mixture (20% isopropanol plus 10% of Tween 80) then was added to the media. The pH was adapted to 7.0.

Utilization of cholesterol by bacterial isolates was evaluated *via* the growth of bacteria on these plates after 7 days of incubation at 37ºC ***(Wali et al., 2019).***

3. Screening of bacterial isolates for cholesterol reduction in liquid medium:

The positively grown bacteria on (MSC) agar plates were incubated for 7 days in MSC broth media for 7 days at 37ºC. The enzymatic colorimetric cholesterol oxidase-peroxidase (POD) method was used to assess the ability of bacterial isolates to degrade cholesterol ***(Kulkarni et al., 2013)***. The assay was carried out by the estimation kit of cholesterol (Spinreact). The reagents were reconstructed according to the kit's instructions and the concentration of cholesterol standard was 200 mg/dL. All of the reagents were thoroughly mixed in accordance with the manufacturer's instructions. 10 µL of cell free supernatant (CFS) was added to the reaction mixture, mixed by inversion, and incubated for 10 minutes at 37ºC. At ƛ 505 nm, the absorbance of the test and standard was compared to that of the blank. Uninoculated tube was served as control. The following formula was used to calculate cholesterol concentration:

Cholesterol (mg/dL) = {Absorbance of test / Absorbance of standard} x Conc. of standard (mg/dL).

Furthermore, the cholesterol reduction (mg/dL) and the percent of cholesterol reduction were assessed.

4. Biochemical identification and characterization of the most potent cholesterol reduction isolates:

The most effective cholesterol reducer isolate was inoculated into the VITEK®2 Compact (bioMérieux) identification strip. Strains were cultured on MRS

agar for 18–24 hours at 37ºC before analysis. The suspension of bacteria was adjusted to a McFarland standard of 0.50. The time it took to prepare the solution and fill the card was always less than 1 hour. Anaerobic and *Corynebacterial* identification cards (ANC) were used in the analysis. Every 15 minutes, the ANC Card was read automatically ***(Lee et al., 2011)***.

5. Optimization of cultural conditions for cholesterol reduction:

The tested isolate was inoculated in liquid basal cholesterol medium, many growth conditions influencing cholesterol degradation were investigated, e.g. incubation temperatures (25-50ºC) and incubation periods (2-10 days); pH values (4-9). Various concentrations of cholesterol (0.25-1.5 g/L) and carbon sources (sucrose, glucose, fructose, lactose and maltose) at a final carbon source concentration 1 w/v. Nitrogen sources including organic nitrogen sources (beef extract, meat extract, yeast extract and peptone); inorganic nitrogen sources (ammonium chloride, sodium nitrate and ammonium sulphate) were added to medium at concentration that was equimolecular to 17 g of NH_4NO_3 and phosphorus sources (KH_2PO_4, Na_2HPO_4 and NaH_2PO_4) also were investigated. The cholesterol degradation assay was carried out, after the bacterial isolate was grown at under various conditions.

Bacterial suspension was exposed to UV light irradiation for different times (30, 40, 50 and 60 min.) at distance 20 cm from the UV source (254 nm). Then 100 µL from bacterial suspension at each tested time was taken and spread on nutrient medium agar which incubated at 37ºC for 24 hours. Then changes in count and morphogenesis in colony were determined and the suspected mutated bacteria were screened to determine their ability to reduce cholesterol ***(Jaivel and Marimuthu, 2010)***.

Results and Discussion:

Fourteen isolates of bacteria were investigated for their growth on MSC agar media for 7 days at 37ºC. All bacterial isolates utilized cholesterol and well-grown on MSC agar media (Figure 1) which agree with the results obtained by ***Wali et al (2019)*** for growth of *Bacillus pumilus* W1 and *Serratia marcescens* W8.

The purified 14 probiotic bacteria (Table 1) were screened to compare their effect in the reduction of cholesterol and the result showed that the bacterial isolate no. (LAB 8) isolated from cow milk was the most potent

cholesterol reducer by (33.07%) (Table 2). The obtained results agree with many authors who recorded the capability of various bacteria to lower the cholesterol in a liquid media such as ***Kulkarni et al (2013)*** who reported that the isolated bacteria from raw cow's milk revealed a cholesterol lowering activity and ***Khiralla (2015)*** who observed that the *Lactobacillius* isolates were the cholesterol reducer isolates. On other hand many studies which recorded the ability of *actinomyctes* to reduce cholesterol level in liquid media as, ***El-Naggar and El-Shweihy (2020)*** who demonstrate that *Streptomyces anulatus* as cholesterol remover isolate.

The biochemical identification tests by VITEK®2 identified the isolate no. (LAB 8) as *Lactobacillus plantarum* (Table 3).

The optimum incubation period for the maximum growth and cholesterol degradation by *Lactobacillus plantarum* was achieved after 6 days of incubation (Figure 2). The obtained results agree with the results conducted by ***ElBaz et al. (2017)*** who isolated *Bacillus pumilus* and recorded high cholesterol degradation after 6 days of incubation. On the other hand, ***Abou-Saty (2009)*** recorded that the maximum cholesterol degradation by *Streptomyces corchorusii* CX-3 was obtained after 10 days of incubation.

The optimal incubation temperature for the cholesterol degradation by *Lactobacillus plantarum* was 37ºC (Figure 3). These results in agreement with the results obtained by ***Aboseidah et al. (2017)*** who observed that 37ºC was the optimal incubation temperature for cholesterol reduction by *Enterococcus. faecalis* W7 and *Enterococcus faecium* Y1. On other hand, many authors recorded that the optimal incubation temperature for cholesterol degradation by *Rhodococcus sp*. NCIM 2891 and *Streptomyces cavourensis* NEAE-42 was 30ºC ***(Ahmad and Goswami, 2013)*** and ***(El-Naggar et al., 2016)***, 35ºC for *Bacillus pumilus* W1 and *Serratia marcescens* W8 ***(Wali et al., 2019)***.

The obtained results indicated that the pH 7.0 was the optimum pH for *Lactobacillus plantarum* to achieve the maximal growth and cholesterol degradation by (Figure 4) that comes in agreement with results reported by ***Saranya et al (2014)*** who observed that the pH 7.0 was the optimal pH for *Bacillus* sp to lower the cholesterol and produce the cholesterol oxidase. These results contrasted with the results obtained by ***Yazdi et al. (2001)***

who recorded that the optimal pH value for *Streptomyces fradiae* to decompose the cholesterol was 7.2.

The cholesterol in the present study was the sole source of carbon and its varying concentrations affect its decomposition. The maximum degradation was achieved at a concentration of 0.75 g/L (Figure 5). Even so, with increasing in cholesterol concentration increased, the hypocholestermic activity of *Lactobacillus plantarium* decreased significantly. This is consistent with the findings of Ouf *et al.* (2012), who found that the high concentrations of cholesterol were degraded more slowly than the low concentrations by *Streptomyces* cholesterol oxidase.

The results showed that the addition of maltose to the medium of growth elevated the cholesterol lowering activity of *Lactobacillus plantarum* compared with the case of maltose-free medium (Figure 6), while any increase in maltose concentration more than 1 g/100 mL inhibited the bacterial ability of cholesterol reduction.

In the present investigation the NH_4NO_3 was the optimal nitrogen source for degradation cholesterol by *Lactobacillus plantarum* (Figure7) which agree with the results obtained by ***Ouf et al. (2012)*** who noticed that the most appropriate nitrogen sources for the non-irradiated and radiated *Streptomyces fradiae* to reduce the cholesterol were NH_4NO_3 and $Mg(NO_3)_2$ On the other hand, several studies such as ***Lee et al (1997)*** *and* ***Yazdi et al (2001)*** observed the yeast extract as the best nitrogen source for cholesterol degradation by *Rhodococcus equi* no. 23 and *Rhodococcus equi* 2C, respectively.

The results showed that K_2HPO_4 was the optimal phosphorus source for cholesterol degradation by *Lactobacillus plantarum* **(Figure 8)** this agree with results obtained by ***Kim et al. (2002)*** who mentioned that the optimal phosphate source for cholesterol degradation by *Bacillus subtilis* was K_2HPO_4 (0.025%).

Genetic improvement is one of the promising approaches for increased production of secondary metabolites by industrially important microorganisms. In the current study mutation was performed physically by using UV irradiation treatment led to change in count and morphology of the bacterial colonies (Figure 9) and by determination of reduction cholesterol percent by the mutant isolate it was found increasing in reduction of cholesterol (Figure 10) these results were agreed with ***Jaivel and Marimuthu (2010)*** who reported that the mutant JPM3-UV1 produced the maximum lovastatin comparing to the parent culture.

Table (1) *Isolation of probiotic bacteria (lactic acid bacteria) from different milk sources.*

Source		LAB growth
Buffalo milk		
Sample 1		**+ve**
	Sample 2	**+ve**
	Sample 3	**+ve**
	Sample 4	**+ve**
	Sample 5	**+ve**
	Sample 6	**+ve**
Chesse whey	**Sample 1**	**+ve**
Cow milk	**Sample 1**	
	Sample 2	**+ve**
Goat milk	**Sample 1**	**+ve**
Gohania milk	**Sample 1**	**+ve**
Lactiuol milk	**Sample 1**	**+ve**
Salt cheese whey	**Sample 1**	**+ve**
Yogurt	**Sample 1**	**+ve**
	Sample 2	**+ve**

LAB growth*: lactic acid bacteria growth;* ***Positive growth****: **+ve; Negative growth: -ve.***

Table (2): *Biochemical identification tests for identification of (LAB 8) by VITEK2.*

Identification information	**Card: ANC**	**Lot Number 242087403**	**Expires: Apr 20,2020 13:00**
	Completed: Feb 23,2020 19:54 CST	**Status: Final**	**Analysis Time: 6.98 hours**
Organism origin	**VITEK 2**		
Selected Organism	**99% probability *Lactobacillus plantarum* Bionumber:000010721773731**		
SRF Organism			
Analysis organisms and Tests to Separate:			
Analysis message:			
Contraindicating Typical Biopattern(s) ***Lactobacillus plantarum***			
Biochemical details: Installed VITEK 2 System Version: 05.02			

4	**dGAL**	**-**	**5**	**LeuA**	**+**	**6**	**ELLM**	**-**	**7**	**PheA**	**+**	**8**	
11	**dCEL**	**+**	**13**	**TyrA**	**-**	**15**	**APPA**	**-**	**18**	**dGLU**	**+**	**20**	**d**
28	**SAC**	**+**	**30**	**ARB**	**+**	**33**	**NAG**	**+**	**34**	**BGLUi**	**+**	**36**	
39	**GALi**	**-**	**41**	**AARA**	**-**	**42**	**AGALi**	**-**	**43**	**BMAN**	**-**	**44**	
51	**MTE**	**-**	**53**	**ESC**	**+**	**54**	**BdFUC**	**-**	**55**	**BNAGi**	**-**	**56**	*A*
59	**PHOS**	**-**	**60**	**lARA**	**-**	**61**	**dRIB2**	**-**	**62**	**OPS**	**+**	**63**	*A*

MIC Interpretation guideline:
Therapeutic Interpretation guideline:
AES Parameter Set Name:
AES Parameter Last Modified:

Table (3): *Screening of bacterial isolates for cholesterol reduction in cholesterol liquid media.*

Isolates	Cholesterol residual (mg/dL)	% of Cholesterol reduction
LAB1	**70.57**	**22.19**
LAB 2	**71.68**	**20.97**
LAB 3	**76.68**	**15.45**
LAB 4	**72.60**	**19.90**
LAB 5	**74.42**	**17.90**
LAB 6	**68.94**	**23.99**
LAB 7	**68.98**	**23.90**
LAB 8	**60.70**	**33.07**
LAB 9	**67.20**	**25.90**
LAB10	**61.5**	**32.19**
LAB11	**63.35**	**30.15**
LAB12	**63.40**	**30.00**
LAB13	**72.00**	**20.60**
LAB14	**71.50**	**21.16**

LAB: Lactic acid bacteria, Control =90.7.

Figure (1): Positive growth of bacteria on cholesterol agar plate.

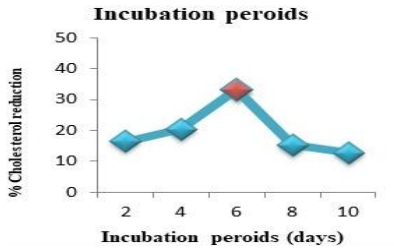


Figure (2): Effect of different incubation periods on cholesterol reduction by *Lactobacillus plantarum*

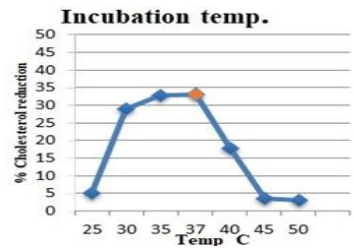
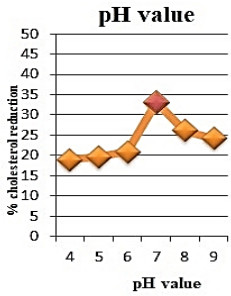
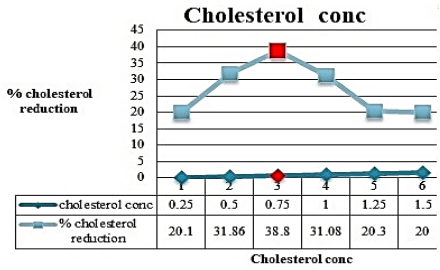


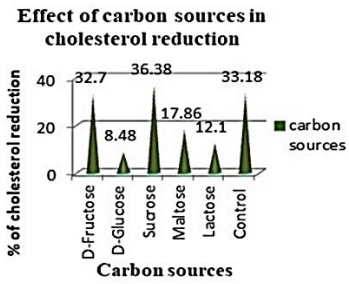
Figure (3): Effect of different incubation temperatures on cholesterol reduction by *Lactobacillus plantarum*



Figure·(4):·Effect·of·different·pH·values·on·cholesterol·reduction·by·*Lactobacillus·plantarum*¶



Figure·(5):·Effect·of·different·cholesterol·concentration·on·cholesterol·reduction·by·*Lactobacillus·plantarum*¶



Figure(6):· Effect· of· different· carbon· sources· on· cholesterol· reduction· by· *Lactiplantibacillus plantarum*¤

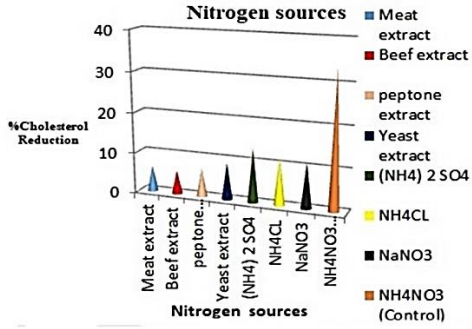


Fig.·(7):·Effect·of·different·nitrogen·sources·on·cholesterol·reduction·by·*Lactiplantibacillus·plantarum*¤

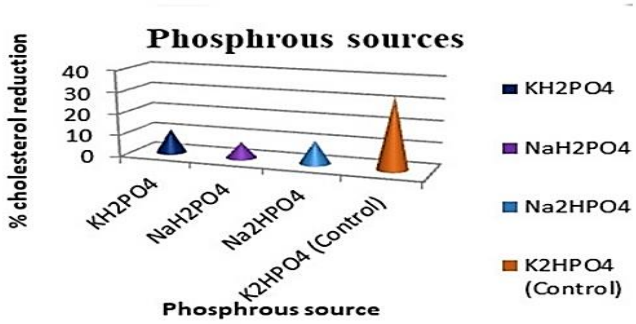
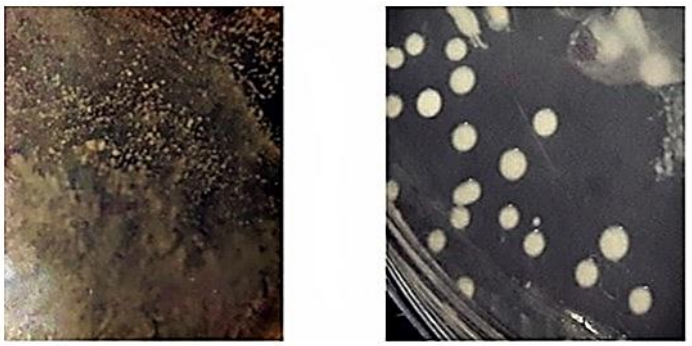


Fig.(8)·Effect·of·different·phosphrous·on·cholesterol· reduction·by·*Lactiplantibacillus· plantarum*¤



(a) **(b)**

Figure (9): The effect of UV light on count and morphogenesis of *Lactobacillus plantarum* a, the bacterial growth at zero time; b, the bacterial growth after 60 min of UV exposure

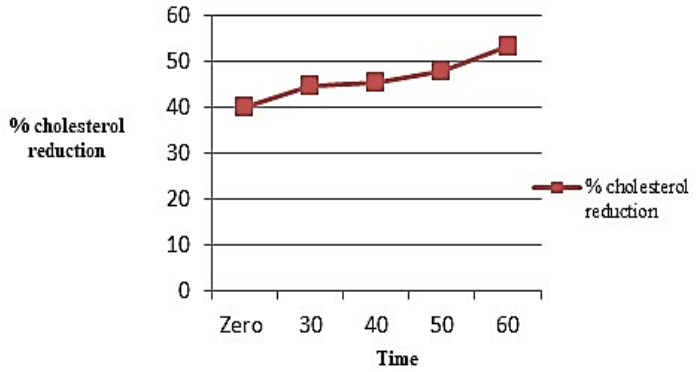


Figure (10): Effect of UV radiation exposure on cholesterol reduction.

Reference:

Aboseidah, A. A., Rasmey, A. H. M., Osman, M. M., Desouky, S. G. and Kamal, N. (2017). Cholesterol reduction in vitro by novel probiotic lactic acid bacterial strains of *Enterococcus* isolated from healthy infants' stool. Afr. J. Microbiol. Res., 11(38), 1434-1444.

Abou-Saty, A. I. M. (2009). Biodegradation of cholesterol by some soil actinomycetes. Master D. Thesis, Fac. Sci., Zagazig Univ., Egypt.

Ahmad, S. and Goswami, P. (2013). Enhanced production of cell-bound cholesterol oxidase from *Rhodococcus* sp. NCIM 2891 by the statistical method. Ann. Microbiol, 63(1), 199-205.

ElBaz, F. N., Gamal, R. F., ElBaz, A. F., Ibrahim, N. E. and ElMekawy, A. (2017). Biochemical and biotechnological studies on a novel purified Bacillus cholesterol oxidase tolerant to solvent and thermal stress. Biocatal. Biotransformation, 35(3), 205-214.

El-Naggar, N. E. A. and El-Shweihy, N. M. (2020). Identification of cholesterol-assimilating actinomycetes strain and application of statistical modeling approaches for improvement of cholesterol oxidase production by *Streptomyces anulatus* strain NEAE-94. BMC microbiology, 20, 1-18.

El-Naggar, N. E. A., El-Shweihy, N. M. and El-Ewasy, S. M. (2016). Identification and statistical optimization of fermentation conditions for a newly isolated extracellular cholesterol oxidase-producing *Streptomyces cavourensis* strain NEAE-42. BMC microbiology, 16(1), 1-20.

Hlivak, P., Odraska, J., Ferencik, M., Ebringer, L., Jahnova, E. and Mikes, Z. (2005). One-year application of probiotic strain *Enterococcus faecium* M-74 decreases serum cholesterol levels. Bratisl Lek Listy, 106(2), 67-72

Jaivel, N. and Marimuthu, P. (2010). Strain improvement of *Aspergillus terrus* for increased lovastatin production. Int. J. Eng. Sci. Technol, 2(7), 2612-2615.

Khiralla, G. M. (2015). Cholesterol degradation by some bacteria isolated from food. Food Sci. Technol., 21(5), 685-693.

Kim, K. P., Rhee, C. H. and Park, H. D. (2002). Degradation of cholesterol by *Bacillus subtilis* SFF34 isolated from Korean traditional fermented flatfish. Lett. Appl, 35(6), 468-472.

Kulkarni, N. S., Lokhande, A. P., Pachori, R. R., Agrawal, P. N. and Dalal, J. M. (2013). Screening of the cholesterol degrading bacteria from cow's milk. Curr Res Microbiol Biotechnol, 1(3), 92-94.

Lee, E. H. L., Degener, J. E., Welling, G. W. and Veloo, A. C. M. (2011). Evaluation of the Vitek 2 ANC card for identification of clinical isolates of anaerobic bacteria. J. Clin. Microbiol., 49(5), 1745-1749.

Lee, M. T., Chen, W. C. and Chou, C. C. (1997). Nutritional factors that affect the production of cholesterol oxidase by *Rhodococcus equi* no. 23. Biotechnol. Appl. Biochem., 26(3), 159-162.

Mann, G. V. and Spoerry, A. (1974). Studies of a surfactant and cholesteremia in the Maasai. Am. J. Clin. Nutr., 27(5), 464-469.

Nishiya, Y., Harada, N., Teshima, S. I., Yamashita, M., Fujii, I., Hirayama, N. and Murooka, Y. (1997). Improvement of thermal stability of Streptomyces cholesterol oxidase by random mutagenesis and a structural interpretation. Protein Eng., 10(3), 231-235.

Ouf, S. A., Alsarrani, A. Q., Al-Adly, A. A. and Ibrahim, M. K. (2012). Evaluation of low-intensity laser radiation on stimulating the cholesterol degrading activity: Part I. Microorganisms isolated from cholesterol-rich materials. Saudi J. Biol. Sci., 19(2), 185-193.

Palani Kumar, M. K., Halami, P. M. and Serva Peddha, M. (2021): Effect of *Lactobacillus fermentum* MCC2760-Based Probiotic Curd on Hypercholesterolemic C57BL6 Mice. ACS omega. 6(11), 7701-7710.

Pan, D. D., Zeng, X. Q. and Yan, Y. T. (2011). Characterisation of *Lactobacillus fermentum* SM-7 isolated from koumiss, a potential probiotic bacterium with cholesterol-lowering effects. J. Sci. Food Agric., 91(3), 512-518.

Pereira, D. I. and Gibson, G. R. (2002). Effects of consumption of probiotics and prebiotics on serum lipid levels in humans. Crit. Rev. Biochem. Mol, 37(4), 259-281.

Russell, D. W. (2003). The enzymes, regulation, and genetics of bile acid synthesis. Annu. Rev. Biochem., 72(1), 137-174.

Saavedra, L., Taranto, M. P., Sesma, F. and de Valdez, G. F. (2003). Homemade traditional cheeses for the isolation of probiotic *Enterococcus faecium* strains. Int. J. Food Microbiol., 88(2-3), 241-245.

Saranya, S., Shekinah, S., Rajagopal, T., Vijayakumar, J. and Ponmanickam, P. (2014). Isolation and characterization of cholesterol degrading bacteria from soap and vegetable oil industrial waste. nopr.niscair.res.

Tsai, C. C., Lin, P. P., Hsieh, Y. M., Zhang, Z. Y., Wu, H. C. and Huang, C. C. (2014). Cholesterol-lowering potentials of lactic acid bacteria based on bile-salt hydrolase activity and effect of potent strains on cholesterol metabolism *in vitro* and *in vivo*. Sci. World J, 2014, 10.

Wali, H., Rehman, F. U., Umar, A. and Ahmed, S. (2019). Cholesterol degradation and production of extracellular cholesterol oxidase from *Bacillus pumilus* W1 and *Serratia marcescens* W8. Biomed Res. Int 2019.

Wang, J., Zhang, H., Chen, X., Chen, Y. and Bao, Q. (2012). Selection of potential probiotic lactobacilli for cholesterol-lowering properties and their effect on cholesterol metabolism in rats fed a high-lipid diet. Int. J. Dairy Sci., 95(4), 1645-1654.

WHO. (2002). Guidelines for evaluating probiotics in food.

Yazdi, M. T., Malekzadeh, F., Zarrini, G. H., Faramarzi, M. A., Kamranpour, N. and Khaleghparast, S. H. (2001). Production of cholesterol oxidase by a newly isolated *Rhodococcus* sp. World J. Microbiol. Biotechnol, 17(7), 731-737.

Yehia, H. M., Hassanein, W. A. and Ibraheim, S. M. (2015). Purification and characterisation of the extracellular cholesterol oxidase enzyme from *Enterococcus hirae*. BMC microbiology, 15(1), 1-12.

Young, D. S. (2001). Effect of drugs on clinical lab tests. 4th.

الملخص العربى

خفض الكوليسترول بواسطة بكتيريا اللاكتوباسيلس النافعة المعزولة من لبن البقر

محمد عبد الرازق, محمد فاروق غالى, سمر محمد

الهدف الرئيسي من هذه الدراسة هو عزل و دراسة تأثير بعض بكتيريا البروبيوتيك من مصادر مختلفة من الحليب ومنتجات الألبان في خفض نسبة الكوليسترول. تم فحص تأثير ١٤ عزله بكتيرية على خفض الكوليسترول و كانت العزلة (LAB ٨) المعزوله من حليب البقر الأكثر نشاطا في خفض الكوليسترول بنسبة ٣٣,07٪. تم تحسين نشاط العزلة (LAB ٨) فى تخفيض الكوليسترول ليصل إلى ٣,٥٣٪ و ذلك من خلال دراسة الظروف البيئية المختلفة مثل درجات حرارة الحضانة و فترات الحضانة و درجة الحموضة و تركيزات الكوليسترول ومصادر الكربون و مصادر النيتروجين و مصادر الفوسفور و التعرض للأشعة فوق البنفسجية.و أوضحت النتائج أن أعلى نسبة لخفض الكوليسترول بواسطه (LAB ٨) تم الحصول عليها بعد ٦ أيام من الحضانة عند ٣٧ درجة مئوية في الوسط القاعدي (الرقم الهيدروجيني ٧) مع إضافة ٧٥ جم/لتر كوليسترول كركيزة مع إضافة المالتوز بتركيز١جم/١٠٠ مل و بعد التعرض للأشعة فوق البنفسجية لمدة ٦٠ دقيقة. تم التعرف على (LAB ٨) كيميائيًا بواسطة VITEK®2 على أنه *Lactobacillus plantarum*.