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A Mhd On Effect Of Complete Slip On Peristaltic Transport Of Jeffrey Fluid Flow With Suction And Injection

[1] S. Sivaranjani [1*]A. Kavitha
Department Of Mathematics, Vit University, Vellore, Tamil Nadu, India-632014.

Abstract
In these papers, we study the peristaltic transport of a conducting Newtonian fluid in the wave frame of reference, restricted by permeable walls, with suction and injection flowing at constant wave velocity while taking long wavelength low Reynolds number into account. The frictional force, pressure gradient, and velocity field all have analytical solutions. Graphical discussions are held on the impact of the permeability parameter, including slip, amplitude ratio, and suction/injection parameter on the flow amounts. It has been discovered that the pressure rise against the pump operations decreases with increasing suction/ injection parameter. Additionally, when the magnetic parameter rises, so does the pressure rise. It is also observed that for various values of suction and injection parameter k. The frictional forces illustrate the opposite behaviour compared to pressure rise. The graphical representation for the frictional forces and pressure are shown in figure.

Key words: *Peristaltic transport, MHD, Suction and Injection.*

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I. Introduction

The peristaltic mechanism is a crucial breakthrough that has piqued the curiosity of many researchers due to its practical and physiological benefits. There are various glandular ducts throughout the body, including the ureter, digestive system, and bile ducts, which are all known sites for pelvic movement. There are biological processes in nuclear companies, much as blood pumps in the heart and respiratory organ machines transport healthful fluids and cyan genetic fluids. The literature now has multiple findings of activity movements involving both non-Newtonian and Newtonian flow. Newtonian fluids are less useful in industrial, technological, and medicinal applications than non- Newtonian fluids. That was an indisputable fact that was universally acknowledged. Some examples are paints and lubricants with complicated additives, biological fluids with non-Newtonian properties, and products with high quantities of glass or carbon Fibers, intricately formulated paints and lubricants, and biological fluids with non-Newtonian properties are considered suspect.

Studies demonstrating the mass eflux of a Poiseuille flow across a naturally permeable wall are reported by Beavers et al. [1]. A simple theory is put forward, which, by replacing the boundary layer impact with a slip velocity equal to the external velocity gradient, is demonstrated to be quite consistent with experimental results. Fung and colleague’s study [2] investigated the two- dimensional state of moderate motion amplitude peristaltic Pumping. The critical pressure gradient value and the velocity profile are presented in this study.

According to Shapiro et al. [3], pumping with an infinite train of peristaltic waves can be investigated in situations where the pressure is assumed to be constant throughout the cross-section when the required Reynolds number is small enough even for the moment of inertia to be minimal and the wavelength-to- diameter proportion is high enough. The Couette flow between two permeable beds under suction and injection was studied by Sreenadh et al. [4]. The third- grade incompressible MHD fluid housed in a cylindrical tube was examined by Hayat et al. [5]. A generic solution to a third-grade fluid hydrodynamic highly nonlinear problem is developed in this Study. Lastly, examples of third-grade hydrodynamic and Newtonian fluids are used to validate the article's claims. When there are no longer any no-slip limitations at the tube wall, third-grade fluid is compelled to flow peristaltically in the study of Ali et al. [6]. The series solution and the numerical solution are contrasted. The main features of pumping and trapping are described, with particular attention to the effects of slip and non-Newtonian factors. Ali et al. have achieved an accurate solution for the problem of hydrodynamics in a two-dimensional channel with changing viscosity under effect slip conditions, peristaltically studied by Ali et al. [7]. The findings indicate that when a non-Newtonian fluid is included, the maximum pressure rise is greater than when a Newtonian fluid is involved. during the analysis of MHD viscous fluid. In order to find out how mass and heat transfer affect peristaltic fluid flow in a curved tube with compliant walls, Hayat et al. [8] performed a study. The answer is found by running a mathematical model with the assumptions of a long wavelength and a low Reynolds number. The suction and injection of a Carreau fluid during peristaltic motion in a porous media were investigated by Hemadri et al. [9]. It is observed that as the pressure increases to p=0, the pumping rate remains constant.

Hari Prabhakaran et al. [10] used suction and injection to record the peristaltic flow of fourth-grade fluid between two permeable media. In their investigation, Hina et al. [11] investigated the peristaltic motion of a non-Newtonian fluid in a curved channel with wall characteristics and the implications of slip. Excellent agreement is found in this study when the analytical and numerical answers are compared.

Jaffrin and Shaprio provide a review of peristalsis [12]. The longitudinal dispersion of particles in blood moving in a lung alveolar sheet was studied by Tang and Fung [13]. Brasseur et al. [14] expanded the analysis provided for a single fluid to include a two fluid model in a channel. The constant flow of non-Newtonian fluids over a porous plate by suction or injection has been covered by Mansutti et al. [15]. Using suction and injection, Peeyush Chandra et al. [16] studied pulsatile flow in circular tubes with different cross-sections.

Moderate-to-large injection and suction driven channel flows with expanding or contracting walls have been explored by Majdalani and Zhou [17]. Domairry and Aziz [18] offered an approximate analysis of the MHD squeeze flow between two parallel disks with suction or injection using the Homotropy perturbation approach. Peristaltic movement of a Jeffrey fluid across porous walls with suction and injection under velocity secondary slip circumstances has been studied by Hemadri Reddy et al. [19]. Vernekar et al., [20] investigated the peristaltic transport of a Jeffrey fluid in an inclined channel with suction and injection with velocity secondary slip conditions. Blood flow in small blood vessels is reported flow under the mechanism of peristalsis with suction and injection. It is necessary to investigate the peristaltic transport of a viscous fluid in a channel between porous walls with suction and injection because of the numerous physiological applications.

These papers examine, under long wavelength and low Reynolds number assumptions, the peristaltic flow of a viscous fluid in a tapered channel with suction and injection. The fluid is continuously injected into the channel at a velocity V_0 perpendicular to the lower porous bed, and it is pulled out at the same velocity V_0 to the permeable bed. The acquired quantities are the velocity, the stream function, the pressure increase, and the friction force.

II. Mathematical Formulation

Consider the effects of complete slip on peristaltic pumping of a Jeffrey fluid in a tapered channel of half width a. A longitudinal train of progressive sinusoidal waves takes place on the upper and lower walls of the channel. The fluid is injected into the channel perpendicular to the lower wall with a constant velocity V_0 and is sucked out of the upper wall with the same velocity V_0 and is sucked out of the upper wall with the same velocity V_0.

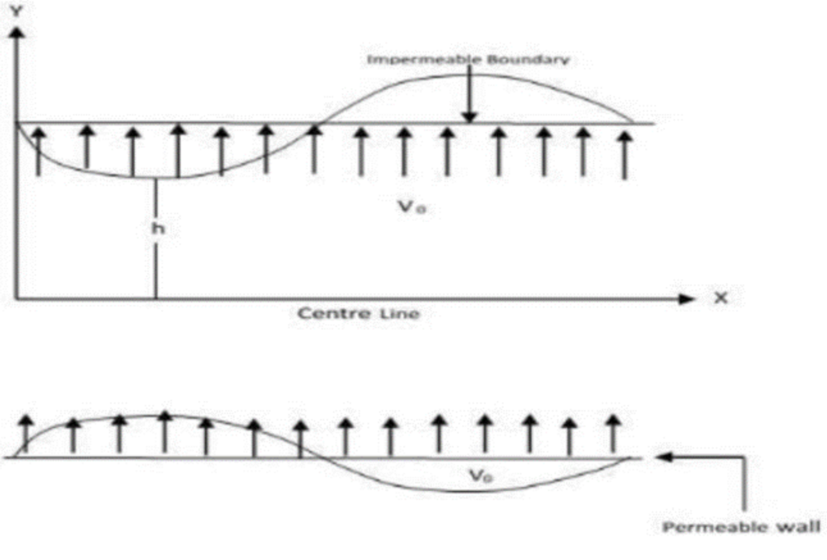


Figure 1: Physical Model

FIGURE.1

For simplicity, we restrict our discussion to the half width of the channel. The wall deformation is given by

$$H(X,t) = a + mX + bsin\frac{2\pi}{\lambda}(X - ct) \qquad (1)$$

Where b is the amplitude, λ is the wavelength and c is the wave speed.

Under the assumptions that the tube length is an integral multiple of the wavelength λ and the pressure difference across the ends of the tube is a constant, the flow becomes steady in the wave frame (x, y) moving with velocity c away from the fixed (laboratory) frame (X, Y). The transformation between these two frames is given by

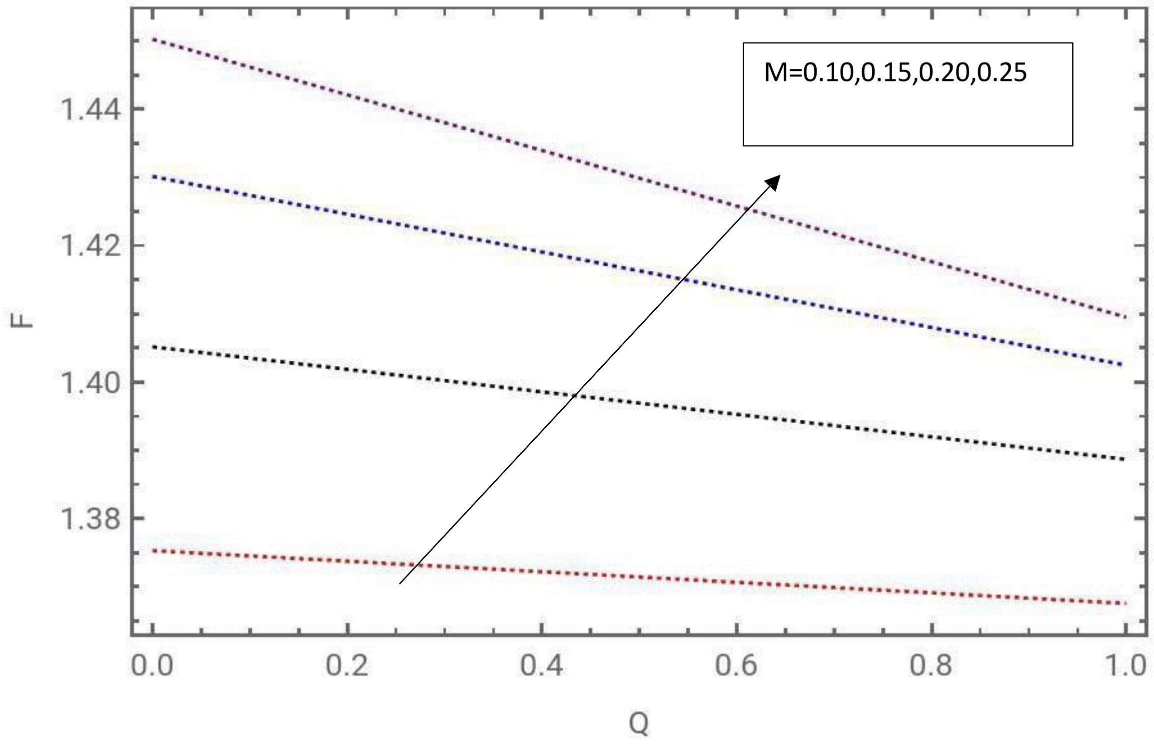
$$x = X - c\,t,\ y = Y,\ u(x, y) = U(X - c\,t, Y) - c,\ v(x, y) = V(X - c\,t, y) \qquad (2)$$

Where U and V are velocity components in the laboratory frame and u, v are velocity components in the wave frame. Further, we assume that the wavelength is infinite. So the flow is Poiseuille type at each local cross-section.

III. Result And Discussion

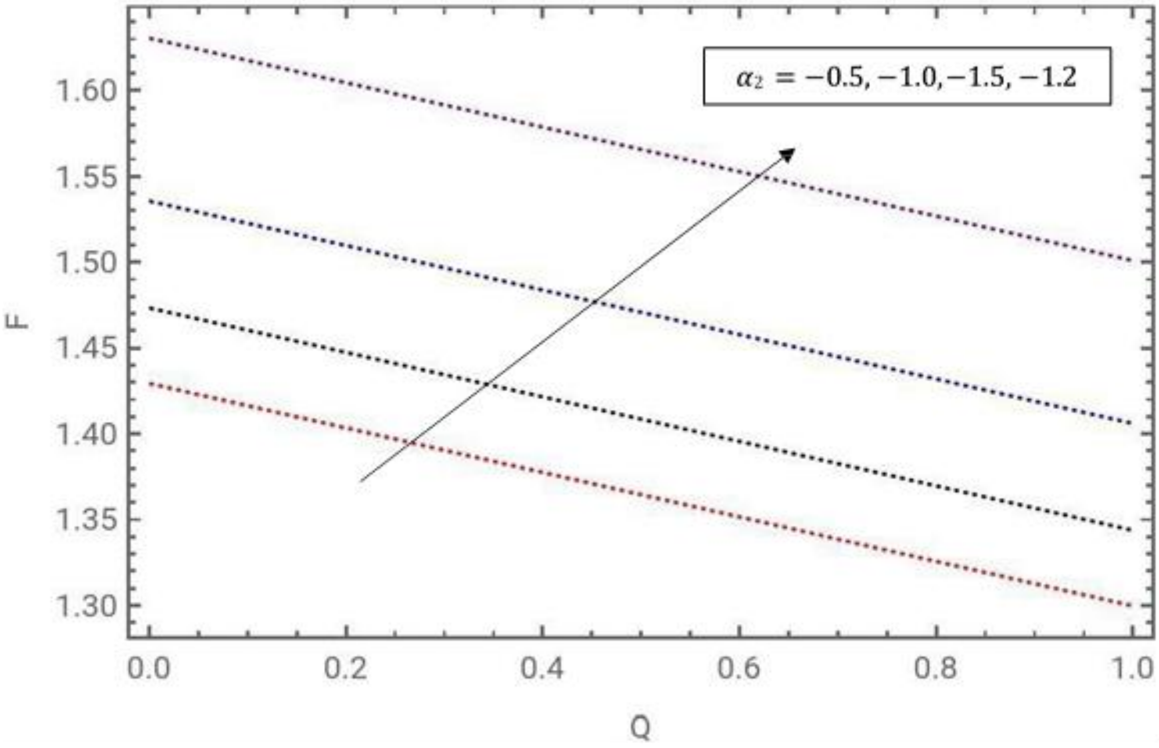
This work aims to investigate magnetohydrodynamic a Newtonian fluid moving in a peristalsis in order to determine the answers in numbers. The program MATHEMATICA is utilized. The effects of the injection and suction parameters (k=0.6,0.7,0.8,0.9) are displayed in Figure 9. The pumping curves and points in the first quadrant with total slip, first-order slip effects and second- order slip effects all are coincide at $Q \cong 0.6$ for a range of values of k. This result of the suction and injection of the channel for $Q>0.6$, we observe that the pressure rate increases as the suction/injection parameter k is raised. For $Q<0.6$, we observe that the pressure rate increases as the suction/injection parameter k decreases. The various values of ϕ (amplitude ratio) on Δ p with fixed other parameters are shown in Figure 10. It is evident that the graph produces the behaviour in the zone of co-pumping ($\Delta p<0$). The curves agree in the free pumping zone ($\Delta p=0$), indicating that pressure decreases in the region ($\Delta p>0$). the impact of the Hartmann number (M=10, 20, 30, 40) on Δ p with fixed other parameters is seen in Figure 13. it is evident that when M grows, the flux rises in the Co-pumping zone. Figure 7 illustrates the Jeffrey parameter's relevance. It is observed that the Jeffrey parameter increases as pressure lowers. Figures 11 and 12 depict the variation in pressure increase for various values of α_1 and α_2, respectively. It is evident that causes a reduction in pressure increase, whereas α_2 experiences a similar phenomenon. Figure 2-6 displays the friction force fluctuations with various values of and α_1, α_2, figure 10 and 13 reveals the dissimilar value of ϕ and M on F with fixed other parameters. It can be observed from these graphs that the friction force initially reduces and gradually rise by increase in ϕ and M. Therefore we conclude from these figures that the friction force F has opposite behaviour when we compared to Δ p.

FIGURE.2



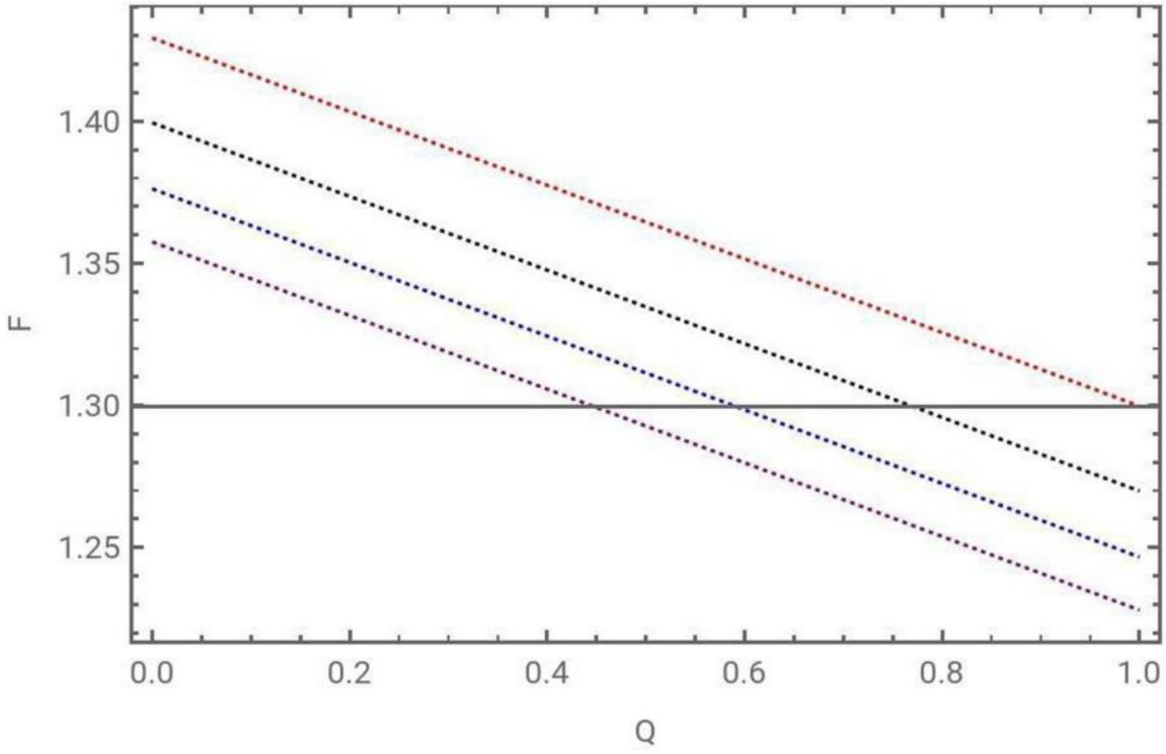
The variation of F with Q for M with ϕ=0.8, a=0.4, α_1=0.5, α_2=0.4, λ=0.5, m=0.005, k=0.1.

FIGURE.3



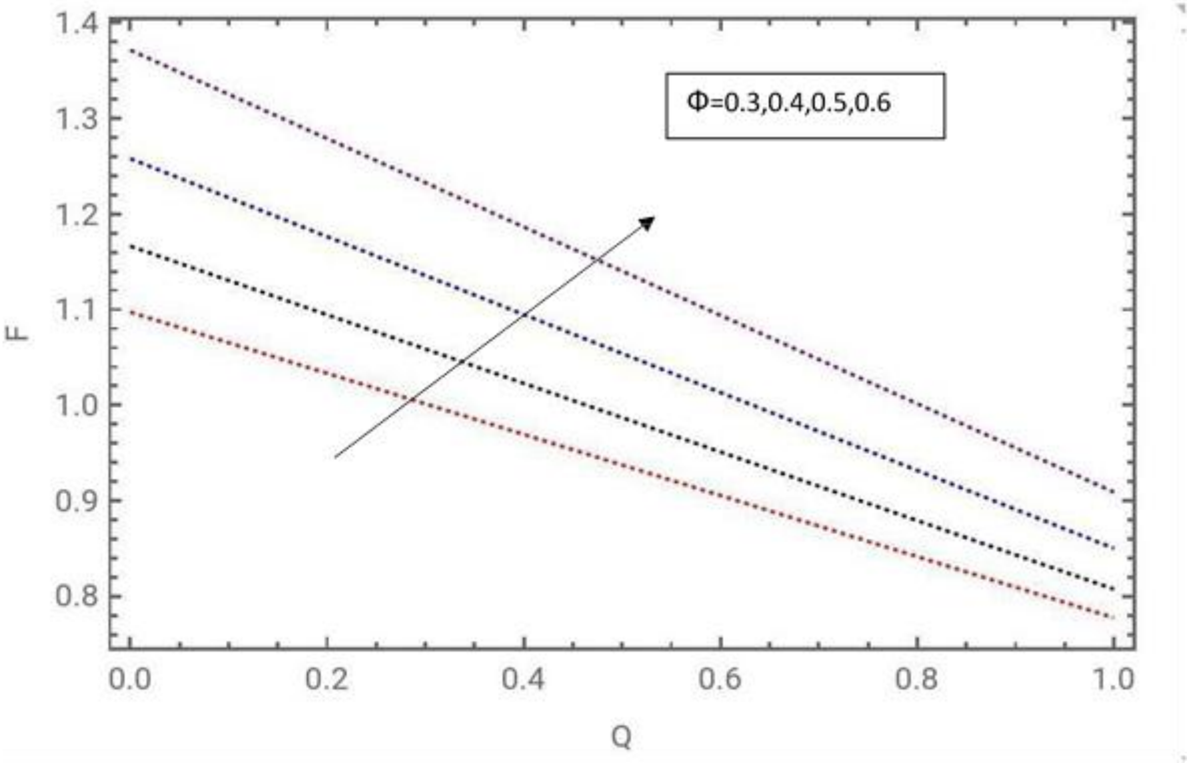
The variation of F with Q for α_2 with ϕ=0.6, a=0.4, α_1=0.5, λ=0.5, m=0.005, k=0.1, M=0.10.

FIGURE 4



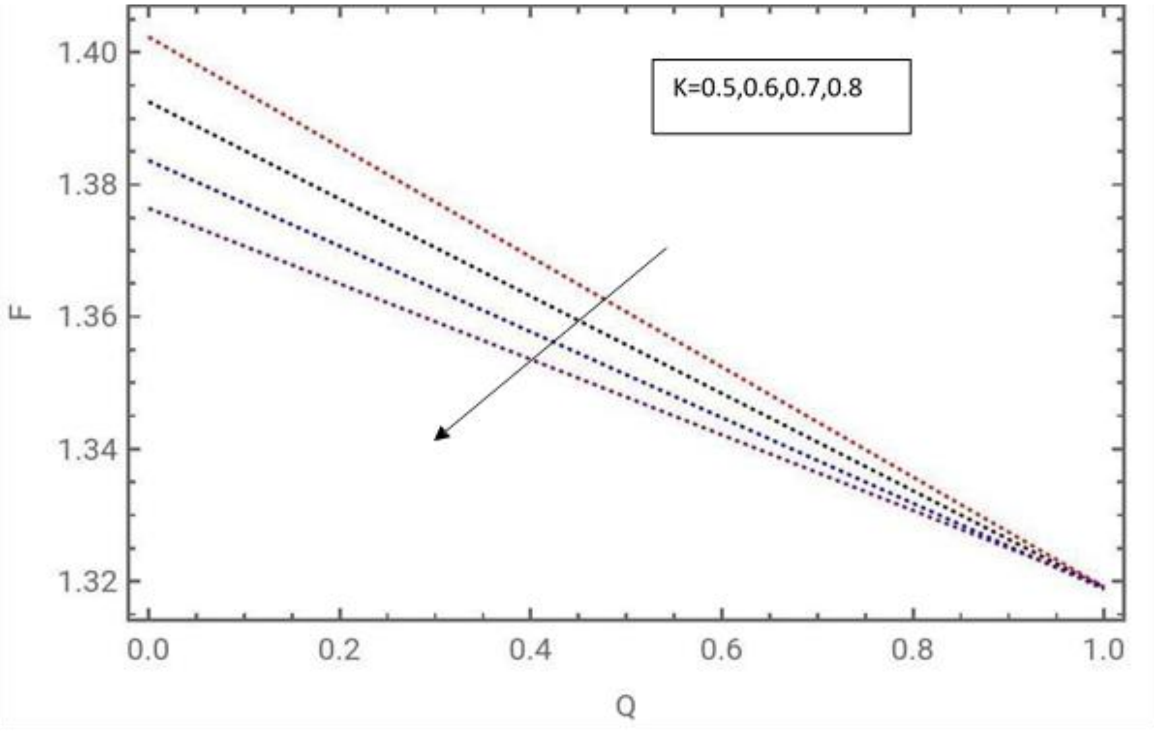
The variation of F with Q for α_1 with ϕ=0.6, a=0,4, α_2=-0.5, λ=0.5, m=0.005, k=0.1, M=0.5.

FIGURE 5



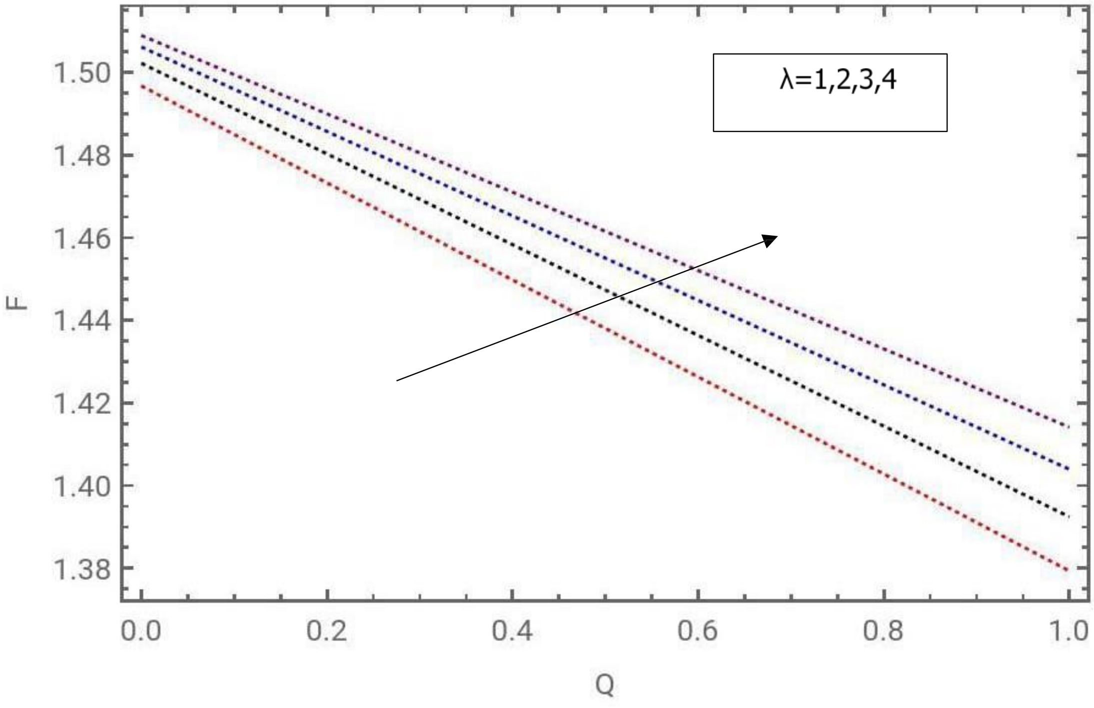
The variation of F with Q for ϕ with a=0.4, α_1=0.5, α_2=0.4, λ=0.5, m=0.005, k=0.1, M=4.

FIGURE 6



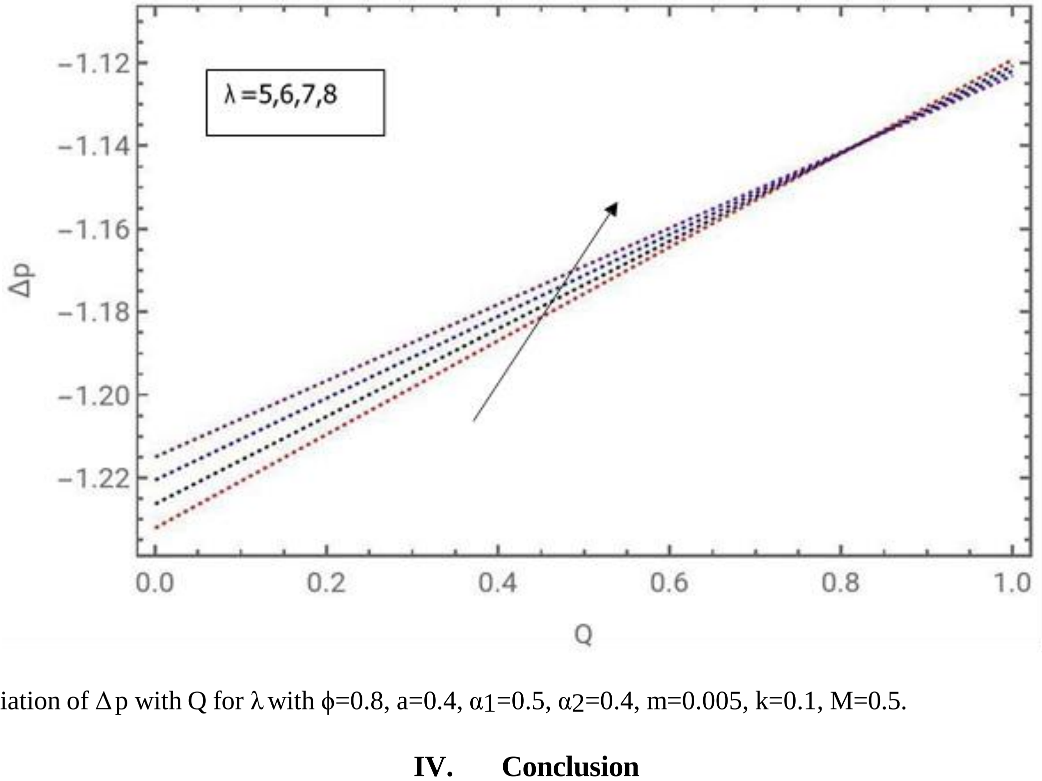
The variation of F with Q for k with ϕ=0.6, a=0.4, α_1=0.5, α_2=-0.5, λ=0.5, m=0.005, M=0.5.

FIGURE 7



The variation of F with Q for λ with ϕ=0.8, a=0.4, α_1=0.5, α_2=0.4, m=0.005, k=0.1, M=0.5.

FIGURE.8



The variation of Δp with Q for λ with ϕ=0.8, a=0.4, α_1=0.5, α_2=0.4, m=0.005, k=0.1, M=0.5.

IV. Conclusion

This paper investigates the peristaltic flow of a viscous fluid under long wavelength and low Reynolds number assumptions in a tapered channel with suction and injection. With a constant velocity V_0, the fluid is injected into the channel perpendicular to the lower porous bed and is sucked out at the same velocity V_0 to the higher permeable bed. The findings are inferred and spoken about. A visual representation of the trapping phenomena for various parameters is shown.

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