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Couple Stress Effects on Peristaltic Transport of Peristaltic Flow of Carreau Fluid in an Inclined Asymmetric Channel with Porous Medium

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Abstract
In this paper, we share a discussion of the Couple Tension Effect on the Peristaltic Transfer of Carreau Peristaltic Flow of Fluid in an Inclined Nonlinear Canal with aPorous Medium the Carreau model's constitutive equation is selected to represent solutions to these problems are obtained A numerical method has been used to answer the problems and consideration, such as perturbation method. Closed form dynamical plus stream function formulas efficiency are pressure was created increase per wave length has been estimated numerically on the channel walls. The Hartman digits impacts (Ha), Darcy digit (Da), amplitude ratio (e), and their consequences. The full effects of axial velocity and entrapment are carefully examined and graphically represented. Numerical results have been computed by using MATHEMATICA software for all these problems and scheming the graphs. At increasing (β_1) the velocity increases in the focal area withe border canal wall but the opposite occur for increasing (Da). And the axial velocity does not change with increasing of (Ha). The pressure of rice for each wavelength ΔP increases in magnitude with increasing values of (Ha).

Keywords: Peristaltic flow**,** Couple Stress**,** Carreau**.**

1. Introduction
The studies of non-Newtonian fluids are not only important but sometimes essential due to their excessive presence in the universe. Therefore, the analysis of different non-Newtonian fluid flows has received a lot of attention from researchers. Particularly peristaltic transport of these fluids was discussed (1-3) Peristalsis is well recognized technique in which a gradual wave of contraction or expansion flows along the channel walls, causing the contents of the channel to shift. This phenomenon generally accurses in a number of biological, medicinal, and technical applications; similar to urinate transfer from kidney to bladder through the ureter, lymphatic vessel transport, heart-lung machine, among other things. Many works on peristaltic flow in various geometries have shown that the non-Newtonian behavior and the non-Newtonian fluid flows have many applications in engineering and medicine, have examined the peristaltic flows of Newtonian and non-Newtonian fluids in symmetric and asymmetric channels. In few other papers, (5) Several scholars in particular biological

problems dealing with conductive fluids are involved in the effect of magnetic field on fluid flow, which is denoted by Magneto hydrodynamics (MHD) as cancer therapy, blood pumping machines, polymer production, and metallurgy. Sensors, magnetic drug, and engineering can all benefit from the MHD Several studies have been steered on MHD peristaltic transport for various fluid models and states due to its many uses (6-9) Peristalsis, a characteristic of smooth muscles and tubes that results from motor activity in many biological systems, carries fluid through channels. The governing Analytical answers have been obtained utilizing the presumption of a long wave-size and a small Reynolds number to create equations for continuity and motion. Studying the impact of new factors on velocity, pressure, and the trapping phenomena are all possible.

2. Materials and Methods

Consider the flow of a Carreau Asymmetric fluid in two dimensions, canal has thickness (E + E′). asymmetrical canals are created thru altering wave amplitudes, the geometries model is:

$h_1(x,t)=E\text{-}r_1\, sin[\frac{2\pi}{\lambda}(x-ct)]$ upper wall (1)

$h_2(x,t)=-E'\text{-}r_2\, sin[\frac{2\pi}{\lambda}(x-ct)+\emptyset]$ lower wall (2)

where r_1, r_2, E, E', λ, c, ∅, t, are the waves amplitudes, channels' width, wavelength, and the speed of wave, $(0 \leq \emptyset \leq \pi)$. The rectangular coordinating system and phase difference are chosen. So that the X-axis is parallel to the axis of the X-axis and the Y-axis is perpendicular to the axis of X-axis. We can mention (∅=0) denotes an equal canal thickness waveform that is outside of phase, whereas (∅ = π) denotes in-phase waves. Furthermore, r1, r2, E, E', are meet the condition:

$r_1^2+r_2^2+2r_1r_2\, cos(\emptyset) \leq (E+E')^2$ (3)

As assumed, there is no longitudinal walls motion. This assumption constrains wall deformation., However, this doesn't imply that the canal is rigid while moving longitudinally.

3. Results

To investigate how physical characteristics affect such as effect on the plotted velocity (u), pressure rise ($\Delta \boldsymbol{p}$) in **Figures (1 and 2)** are clarified graphically by "MATHEMATICA" program

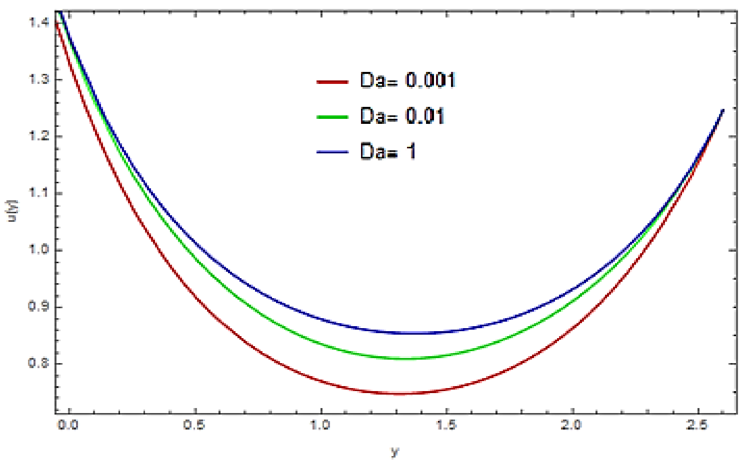

Figure 1. Effectiveness of various parameters of **Da** when Ha=3, β*=0.5, β_1=4, α= 0.4, *e*= 0.5 ,z= 1 ,m= 1, E^*= 0.5.

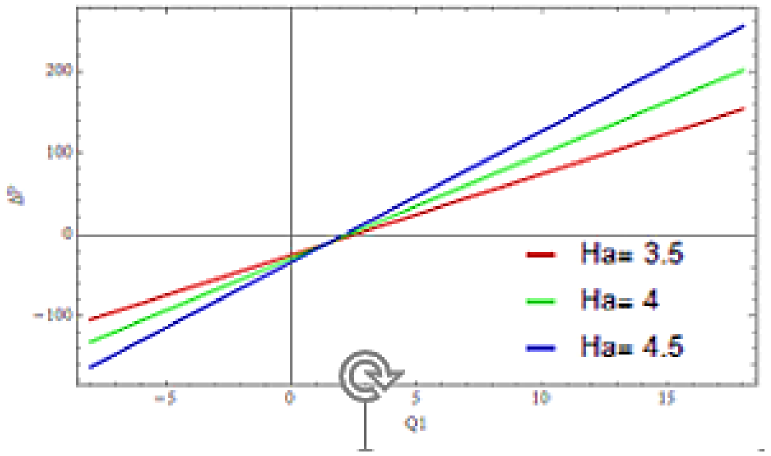

Figure 2. The effectiveness of various **(Ha)** values on pressure (ΔP) while Da=2, β^*=0.5, β_1=4, α=0.4, α^*=0.5, We=3, e=0.5, Re=0.2, Fr=0.2, z= 0.2 ,m= 0.2 , E^*= 0.5, n=1

To solve the problem and find the results, we get the stream function:

$$\psi_{yyyyyy} + \alpha^2\xi\,\psi_{yy} + \alpha^2\psi_{yyyy} = 0 \tag{4}$$

$$\xi = (Ha)^2\cos^2\beta^* + \frac{1}{Da} \tag{5}$$

The answer to the motion equation.is uncomplicated. and may also be written

$$\psi = \sqrt{2}\left(\frac{\sqrt{2}e^{\frac{y\sqrt{-\alpha^2-\sqrt{\alpha^2(\alpha^2-4\xi)}}}{\sqrt{2}}}c1}{\sqrt{-\alpha^2-\sqrt{\alpha^2(\alpha^2-4\xi)}}\sqrt{-\alpha^2-\sqrt{\alpha^4-4\alpha^2\xi}}} + \frac{\sqrt{2}e^{-\frac{y\sqrt{-\alpha^2-\sqrt{\alpha^2(\alpha^2-4\xi)}}}{\sqrt{2}}}c2}{\sqrt{-\alpha^2-\sqrt{\alpha^2(\alpha^2-4\xi)}}\sqrt{-\alpha^2-\sqrt{\alpha^4-4\alpha^2\xi}}} + \frac{\sqrt{2}e^{\frac{y\sqrt{-\alpha^2+\sqrt{\alpha^2(\alpha^2-4\xi)}}}{\sqrt{2}}}c3}{\sqrt{-\alpha^2+\sqrt{\alpha^2(\alpha^2-4\xi)}}\sqrt{-\alpha^2+\sqrt{\alpha^4-4\alpha^2\xi}}} + \frac{\sqrt{2}e^{-\frac{y\sqrt{-\alpha^2+\sqrt{\alpha^2(\alpha^2-4\xi)}}}{\sqrt{2}}}c4}{\sqrt{-\alpha^2+\sqrt{\alpha^2(\alpha^2-4\xi)}}\sqrt{-\alpha^2+\sqrt{\alpha^4-4\alpha^2\xi}}}\right) + c5 + yc6 \tag{6}$$

From Eq. (26) in Eq. (30) we get:

$$\frac{dp}{dx} = -\left[1 + \left(\frac{n-1}{2}\right)(we)^2\left(\psi_{yy}\right)^2\right]\psi_{yyy} - \xi\psi_y - \frac{1}{\alpha^2}\psi_{yyyyy} + \frac{Re}{Fr}\sin\propto^*. \tag{7}$$

From Eq. (31) we get:

$$-\frac{dp}{dy} = 0\,. \tag{8}$$

pressure rise for every wave distance (Δp) is definite :

$$\Delta p = \int_0^1 \frac{\partial p}{\partial x}dx\,. \tag{9}$$

within the defined frame, The provided axial velocity segment

$$u(x, y, t) - 1 = \psi_y \tag{10}$$

4. Discussion

We can see that the impact of (Da) on velocity, we can see velocity decreases with an increase of (Da). the pressure rise (Δp) increased (Δp >-10, Q1 > 2) with a rise (Ha) is the pumping rate decreases in a peristaltic pumping region where (Δp < -10, Q1<2), and the opposite happens in with increasing (Da) and (β^*)

5. Conclusion

A mathematical model was used to inspect the peristaltic motion of Carreau's fluid in an asymmetric porous material. Where this study was conducted to know the consequence of couple stress on peristaltic transport of Carreau fluid peristaltic current.

The results are discussed through graphs, as follows:

1. At increasing (β_1) the velocity increases in the focal area withe border canal wall but the opposite occur for increasing (Da). And the axial velocity does not change with increasing of (Ha).
2. The pressure of rice for each wavelength ΔP increases in magnitude with increasing values of (Ha),

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Conflict of Interest

I am, the researcher Hamza Rashid, declare that there is no conflict of interest.

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