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ORIGINAL ARTICLE

Impact of radiation absorption on Caputo fractional fluid flow over an exponentially accelerated plate

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ABSTRACT – With the advancement of nuclear energy as one of the top clean energy sources, studies on radiation effects are becoming more popular. Radiation absorption is an exothermic phenomenon where radiative energy is released to the surrounding environment. This occurrence can be seen widely in the field of manufacturing, biology, medicine and fluid mechanics. In this study, the impact of radiation absorption of fluid flow over a vertical plate that is exponentially accelerating will be investigated. Heat and mass transfer flowing vertically over the y-axis for $y > 0$ is considered in the presence of uniform magnetic field. At $t > 0$, temperature and concentration gradient would also increase exponentially. Governing partial differential equations are modified into a fractional model via the Caputo fractional derivative. It is then reduced to an ordinary system with Laplace transform and later solved using Zakian's inverse Laplace transform. Solutions of velocity, temperature and concentration profiles are presented graphically with varied values of fractional parameter, α, radiation absorption, Q, Prandtl number, Pr, Schmidt number, Sc, and magnetic parameter, M. Effect of radiation absorption is analysed for each varied result by comparing solutions with and without Q. It is observed that fluid velocity increases with Q and decreases with an increase in Pr, Sc, and M. Fluid tends to reach steady state faster as α increases. Velocity profile decreases with absence of Q. While Temperature profile is unaffected by change in Q. Obtained solutions are compared with published results and it is found that they are in agreement with each other. .

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INTRODUCTION

The discovery of radiation has led to some of the biggest world events in human history. Such as the invention of atomic bombs to applying its smoke detectors. Over the years, there have been countless investigations on the effect of radiation on fluid flow. Recently, studies on the effect of radiation absorption have become a trend due to highly significant contributions to mankind such as nuclear power plant.

One of the earliest work on radiation absorption was done by Ibrahim et al. [1]. An unsteady MHD fluid flow with radiation absorption and chemical reaction over a semi-infinite permeable vertical moving plate with heat source and suction were considered. The study concluded that the buoyancy force increases since the significant amount of radiation absorption parameters corresponds to an increase in the dominance of conduction over radiation absorption when increasing the buoyancy force of the liquid, thus increasing the velocity of the fluid.

Meanwhile, Sreedevi et al. [2] investigated the radiation absorption effect on an MHD double diffusive free convection flow over a stretching sheet with the presence of Hall current. Findings were similar to that of Ibrahim et al. [1] where velocity, temperature and concentration profiles increased with radiation absorption. Then in 2017, Sreedevi et al. [3] continued the similar study by considering Soret and Dufour effects. However, the results from this study suggest that fluid velocity decreases with an increase in radiation absorption.

In the same year, Arifuzzaman et al. [4] conducted a study on the unsteady MHD non-Newtonian flow, Maxwell fluid, with nanoparticles in the presence of chemical reaction and radiation absorption. In this particular study, analysation of radiation absorption was only done on the Nusselt number profile. It dictates that an increase in radiation absorption would result in a decrease of Nusselt number. Arifuzzaman et al. [5] did another study without considering non-Newtonian fluid nor nanoparticles, but instead an oscillatory vertical porous plate with radiation and heat absorption. This time, result with variations of radiation absorption was only done on the temperature profile. It is concluded that the temperature of the fluid increases with an increment in the radiation absorption parameter.

Durga Prasad et al. [6] on the other hand, studied the heat and mass transfer of MHD nanofluid flow with the presence of radiation absorption. Copper, Cu-water and Titanium oxide, TiO_2-water were considered flowing over a moving plate. Solutions were obtained analytically through a small perturbation technique. The findings of the study suggest that fluid velocity, temperature and skin friction are enhanced with an increase in radiation absorption. The effect was more significant with Cu-water nanofluid compared to TiO_2 nanofluid. It is because Cu conducts heat better than TiO_2.

Later on, Veera Krishna and Chamka [7] extended the study by Durga Prasad et al. [6] by considering hall and ion effects with rotating fluid over an infinite vertical plate in a porous medium. Instead of considering Cu-water nanofluid, the authors decided to investigate Silver, Ag-water nanofluid. It is found that both velocity profile and temperature profile increase with an increase in radiation absorption. Not only that, the profiles of that Ag were significantly higher than of TiO_2.

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Ramalingeswara et al. [8] did a study on an MHD fluid flow over an exponentially accelerated porous plate embedded in a porous medium with radiation absorption as well as heat generation and absorption. In his study, the impact of radiation absorption was highlighted. Casson fluid was considered to flow in the y-direction with thermal radiation and heat source or sink. From the study, it is observed that fluid velocity decreases when radiation absorption is increased when the plate cooled down and vice versa. The fluid temperature, on the other hand, increases with radiation absorption. Madhumohana Raju et al. [9] extended the study from Ramalingeswara et al. [8] and considered the Soret effect. The findings are quite similar for radiation absorption parameter.

Based on past literature mentioned, fractional derivatives have not been considered for any problem with radiation absorption. A fractional derivative is defined as a derivative with an order of non-integer number or complex number. Although the geometrical properties of fractional derivates have not been discovered yet, the prospect of it being referred to for future problems are very likely. There are numerous definitions of fractional derivative. Some of them includes Caputo, Caputo-Fabrizio and Antanga-Baleanu.

Back in 2017, Raza [10] investigated the impacts of fractional derivative on a rotational flow of a second grade fluid within an infinite cylinder using the Caputo derivative. Solutions were obtained through Laplace transform and Stehfast algorithm for the inversion transform. The author claims that the hybrid technique in solving the system of PDEs is less time consuming and computational calculations. Findings concluded that fluid velocity increase with an increase in the fractional parameter. Raza et al. [11] continued the same study with a different type of fluid which is Burgers' fluid. Findings from Raza et al. [11] are in good agreement with Raza [10]. Moreover, a comparative study between Caputo and Caputo-Fabrizio using the same condition as that of Raza [10] and Raza et al. [11] were published by Raza et al.[12]. In the same year, Anwar and Rasheed [13] investigated the effects of fractional derivatives on Oldroyd-B nanofluid flow using the Caputo derivative. In this study, fluid is flowing through the lower plate of a confined nonisothermal plate with considering thermophoresis and pedesis effects. Solutions were obtained numerically using a finite difference-finite element scheme. The authors highlighted that an increase in the fractional parameters would result in a higher velocity profile.

Later on, Imran et al. [14] studied fractional models of two types of fluid, viscous and second grade. A comparison between the solutions and the impact of fractional parameters on respective solutions were discussed. The Caputo derivative was considered as well as the effects of Newtonian heating and chemical reaction. The authors presented that velocity profiles for both viscous and second grade fluids were higher with the non-fractional models than their subsequent fractional models.

The following year, Abdullah et al. [15] investigated blood flows containing nanoparticles within a circular cylinder in the uniform magnetic field with Caputo derivative. A similar hybrid technique from Raza [10] was employed to obtain the final solutions of the velocity profile. The authors pointed out that the fractional model produced a better result compared to the classical model, such that it shows a better description of the viscoelastic fluid. It is also pointed out that fractional solutions were perceived to give a more stable behaviour than non-fractional solutions.

Meanwhile, Aman et al. [16] published an article on applying the Caputo time-fractional derivative model in enhancing heat transfer of graphene-water nanofluid that is used in solar panels. An MHD Poiseuille nanofluid flow over a vertical plate with graphene nanoparticles was considered. Modelled fractional PDEs are solved analytically using Laplace transform, and solutions are presented in special functions called Wright functions. The study found that heat transfers are enhanced with an increase in nanoparticle volume fraction and fractional parameters. Khan et al. [17] performed a similar investigation with the Poiseuille flow of an MHD fluid over a vertical stationary plate with non-uniform wall temperature. The findings of that study were similar to that of Aman et al. [16].

In the same year, a study on the natural convection flow in a vertical cylinder was done by Shah et al. [18]. Fractional derivative of Caputo dependent on time was employed in this study by imposing the method of Laplace transform and Hankel transform. Solutions in the frequency domain are then transformed back into the time domain using Stehfest's algorithm. The authors pointed out that the solution for velocity profile with fractional derivatives is faster than that of a classical one. The same conditions were then used by Shah et al. [19] to study the effects of the double convection problem. Imran et al. [20] continued Shah et al.'s [18] study by incorporating boundary conditions of Newtonian heating and arbitrary velocity. Thefindings of Imran et al. [20] are in good agreement with Shah et al. [19].

Lastly, Sarwar et al. [21] studied the effects of slip with an exponentially moving plate that is vertical with Caputo fractional derivative. Interestingly, solutions were obtained through Laplace transforms Stehfest's algorithm as well as Tzu's algorithm. It is highlighted that fluid velocity decreases with an increment in fractional parameters.

To the best of the authors' knowledge, a study on Caputo fractional derivative for an unsteady viscous fluid flow with radiation absorption has not been done. Thus, with these motivations, this study will present the effects of radiation absorption on an unsteady MHD fluid flow over an exponentially accelerated plate via the Caputo fractional derivative and solved it semi-analytically using Laplace transform and Zakian's algorithm.

PROBLEM DEFINITION

The unsteady free convection fluid flow over a vertical plate that is accelerating exponentially is considered in the uniform magnetic field. Fluid flow is assumed to be in the x -direction, taking along the vertical plate in the uphill direction, while y -axis is taken in the direction normal to the plate, and the flow is restricted $y > 0$. At $t = 0$ the plate is at rest, and both the ambient and plate temperatures, as well as the fluid concentration, is assumed to be constant at T_w

and C_W respectively. When t increases, the plate starts to accelerate with velocity $U_0 e^{at}$ where U_0 is initial velocity and a is acceleration of the plate. Meanwhile, both the plate's temperature and fluid concentration will also increase at $y=0$ and remained constant as $y \to \infty$ where temperature and concentration of fluid would approach a constant value. A constant magnitude of a transverse magnetic field is applied perpendicular to the plate. Induced magnetic field, viscous dissipation and electric field are negligible due to the small Reynold number and small value of polarisation effect. The velocity, temperature and concentration are dependant on variables y and t. Based on these assumptions and by utilising Boussineq's approximation, the acquired momentum, energy and concentration equations are as follows [8], [9]:

$$\frac{\partial U(y,t)}{\partial t} = \upsilon \frac{\partial^2 U(y,t)}{\partial y^2} + g\beta_T\left(T-T_\infty\right) + g\beta_C\left(C-C_\infty\right) - \frac{\sigma B_0^{\ 2}}{\rho} U(y,t), \tag{1}$$

$$\frac{\partial T(y,t)}{\partial t} = \frac{k}{\rho C_p} \frac{\partial^2 T(y,t)}{\partial y^2} + Q(C-C_\infty), \tag{2}$$

$$\frac{\partial C(y,t)}{\partial t} = D \frac{\partial^2 C(y,t)}{\partial y^2}, \tag{3}$$

with initial and boundary conditions

$$\begin{array}{lll} U(y,0)=0, & T(y,0)=T_\infty, & C(y,0)=C_\infty, \\ U(0,t)=U_0 e^{at}, & T(0,t)=T_\infty+(T-T_W)e^{at}, & C(0,t)=C_\infty+(C-C_W)e^{at}, \\ U(\infty,t)\to 0, & T(\infty,t)\to T_\infty, & C(\infty,t)\to C_\infty, \end{array} \tag{4}$$

where U, T and C are the velocity, temperature and concentration of the fluid subsequently. Here, υ, g, β_T, β_C, σ, $B_0^{\ 2}$, ρ, k, C_P, Q, D and a are the kinematic viscosity, gravitational acceleration, thermal expansion coefficient, concentration expansion coefficient, electrical conductivity parameter, magnetic field parameter, fluid density, thermal conductivity parameter, specific heat capacity, radiation absorption parameter, mass diffusion coefficient and plate acceleration respectively.

Using dimensionless variables below,

$$\begin{array}{llll} U^* = \dfrac{U^*}{U_0}, & y^* = \dfrac{y^* U_0}{\upsilon}, & T^* = \dfrac{T-T_\infty}{T_W-T_\infty}, & C^* = \dfrac{C-C_\infty}{C_W-C_\infty}, \\ t^* = \dfrac{t^* U_0^{\ 2}}{\upsilon}, & a^* = \dfrac{a\upsilon}{U_0^{\ 2}}, & Gr = \dfrac{\upsilon g\beta(T_W-T_\infty)}{U_0^{\ 3}}, & Gm = \dfrac{\upsilon g\beta(C_W-C_\infty)}{U_0^{\ 3}}, \\ M = \dfrac{\sigma B_0^{\ 2}\upsilon}{\rho U_0^{\ 2}}, & \Pr = \dfrac{\mu C_P}{k}, & Q = \dfrac{\upsilon(C_W-C_\infty)}{U_0^{\ 2}(T_W-T_\infty)\rho C_P}, & Sc = \dfrac{\upsilon}{D}, \end{array} \tag{5}$$

in equations (1)-(4) which obtained fluid paramters Gr, Gm, M, $\Pr$, Q and Sc are thermal Grashof number, mass Grashof number, magnetic field parameter, Prandtl number, radiation absorption parameter and Schmidt number, respectively. By removing the asterisks notations, equations (1)-(4) are obtained as follows:

$$\frac{\partial U(y,t)}{\partial t} = \frac{\partial^2 U(y,t)}{\partial y^2} + GrT(y,t) + GmC(y,t) - MU(y,t), \tag{6}$$

$$\frac{\partial T(y,t)}{\partial t} = \frac{1}{\Pr} \frac{\partial^2 T(y,t)}{\partial y^2} + QC(y,t), \tag{7}$$

$$\frac{\partial C(y,t)}{\partial t} = \frac{1}{Sc} \frac{\partial^2 C(y,t)}{\partial y^2}, \tag{8}$$

with dimensionless conditions

$$\begin{aligned} &U(y,0)=0, \quad T(y,0)=0, \quad C(y,0)=0, \\ &U(0,t)=e^{at}, \quad T(0,t)=e^{at}, \quad C(0,t)=e^{at}, \\ &U(\infty,t)\to 0, \quad T(\infty,t)\to 0, \quad C(\infty,t)\to 0. \end{aligned} \tag{9}$$

Equations (6)-(8) are then modified into a fractional governing equation and are obtained as below [22], [23]:

$$D_t^{\alpha}U(y,t)=\frac{\partial^2 U(y,t)}{\partial y^2}+GrT(y,t)+GmC(y,t)-MU(y,t), \tag{10}$$

$$D_t^{\alpha}T(y,t)=\frac{1}{\Pr}\frac{\partial^2 T(y,t)}{\partial y^2}+QC(y,t), \tag{11}$$

$$D_t^{\alpha}C(y,t)=\frac{1}{Sc}\frac{\partial^2 C(y,t)}{\partial y^2}, \tag{12}$$

where

$$D_t^{\alpha}f(x,t)=\frac{1}{\Gamma(1-\alpha)}\int_0^t \frac{f'(y,t)}{(t-\mu)^{\alpha}}d\mu, \tag{13}$$

is the Caputo fractional derivative with order α and $\Gamma(\cdot)$ is Bernoulli's gamma function.

The solution to the problem

Final solutions of velocity, temperature and concentration profiles are obtained by using Laplace transform and Zakian's inverse Laplace transform. First, the PDEs from equations (10)-(12) are reduced to ODEs via Laplace transform and presented in the frequency domain, such as

$$q^{\alpha}\overline{U}(y,q)=\frac{d^2\overline{U}(y,q)}{\partial y^2}+Gr\overline{T}(y,q)+Gm\overline{C}(y,q)-M\overline{U}(y,q), \tag{14}$$

$$q^{\alpha}\overline{T}(y,q)=\frac{1}{\Pr}\frac{d^2\overline{T}(y,q)}{dy^2}+Q\overline{C}(y,q), \tag{15}$$

$$q^{\alpha}\overline{C}(y,q)=\frac{1}{Sc}\frac{\partial^2\overline{C}(y,q)}{\partial y^2}, \tag{16}$$

with transform boundary equations from (9) as follows:

$$\begin{aligned} &\overline{U}(y,0)=0, \quad \overline{T}(y,0)=0, \quad \overline{C}(y,0)=0, \\ &\overline{U}(0,q)=\frac{1}{q-a}, \quad \overline{T}(0,q)=\frac{1}{q-a}, \quad \overline{C}(0,q)=\frac{1}{q-a}, \\ &\overline{U}(\infty,t)\to 0, \quad \overline{T}(\infty,q)\to 0, \quad \overline{C}(\infty,q)\to 0. \end{aligned} \tag{17}$$

Therefore, the solutions of equations (14)-(16) subjected to conditions (17) are presented as follows:

$$\overline{U}(y,q)=\begin{bmatrix}\frac{1}{q-a}+\frac{Gr}{q-a}\frac{1}{\Pr_1 q^{\alpha}-M}+\frac{Gr\Pr Q}{q-a}\frac{1}{\Pr_0 q^{\alpha}}\frac{1}{Pr_1 q^{\alpha}-M}\\ -\frac{Gr\Pr Q}{q-a}\frac{1}{\Pr_0 q^{\alpha}}\frac{1}{Sc_0 q^{\alpha}-M}+\frac{Gm}{q-a}\frac{1}{Sc_0 q^{\alpha}-M}\end{bmatrix}\exp\left(-y\sqrt{q^{\alpha}+M}\right)$$

$$-\frac{Gr}{q-a}\frac{1}{\Pr_1 q^{\alpha}-M}\exp\left(-y\sqrt{\Pr q^{\alpha}}\right)-\frac{Gr\Pr Q}{q-a}\frac{1}{\Pr_0 q^{\alpha}}\frac{1}{\Pr_1 q^{\alpha}-M}\exp\left(-y\sqrt{\Pr q^{\alpha}}\right) \quad (18)$$

$$+\frac{Gr\Pr Q}{q-a}\frac{1}{\Pr_0 q^{\alpha}}\frac{1}{Sc_0 q^{\alpha}-M}\exp\left(-y\sqrt{Scq^{\alpha}}\right)-\frac{Gm}{q-a}\frac{1}{Sc_0 q^{\alpha}-M}\exp\left(-y\sqrt{Scq^{\alpha}}\right),$$

$$\overline{T}(y,q)=\left[\frac{1}{q-a}+\frac{\Pr Q}{q-a}\frac{1}{\Pr_0 q^{\alpha}}\right]\exp\left(-y\sqrt{\Pr q^{\alpha}}\right)-\frac{\Pr Q}{q-a}\frac{1}{\Pr_0 q^{\alpha}}\exp\left(-y\sqrt{Scq^{\alpha}}\right), \quad (19)$$

$$\overline{C}(y,q)=\frac{1}{q-a}\exp\left(-y\sqrt{Scq^{\alpha}}\right), \quad (20)$$

where

$$\Pr_1=\Pr-1,\quad \Pr_0=Sc-\Pr,\quad Sc_0=Sc-1.$$

are constant parameters. Final solution are obtained by Equations (18)-(20) and using them on the following weighted finite series

$$f(t)=\frac{2}{t}\sum_{j=1}^{n}\mathrm{Re}\left\{K_j F\left(\frac{\alpha_j}{t}\right)\right\}. \quad (21)$$

This method is known as the Zakian's method of inverse Laplace transform method [24], [25].

Table 1. Constant α_j and K_j values of Zakian's method.

j	α_j	K_j
1	12.83767675+1.666063445i	-36902.08210+196990.4257i
2	12.22613209+5.012718792i	61277.02524-95408.62551i
3	10.93430308+8.409673116i	-28916.56288+18169.18531i
4	8.776434715+11.92185389i	4655.361138-1.901528642i
5	5.225453361+15.72952905i	-118.7414011-141.3036911i

Table 1 shows values of constants K_j and α_j are taken from Hassanzadeh et al. [24] when the free paramter n is set to 5. Obtained soultions are presented graphically in Results and Discussions section.

RESULTS AND DISCUSSION

Effects of radiation absorption Q on an unsteady MHD fluid flow over an exponentially accelerated plate is investigated. Solutions as presented in equations (18)-(20) are graphically analysed via Zakian's inverse Laplace transform with Mathcad-15. Figure 1 shows the validation of current result with published result. Similar validation is done numerically and is displayed in table 2. Figures 2-8 shows velocity, temperature and concentration profiles with various values of Q, α, M, $\Pr$, and Sc. From each of the figures, the impact of the radiation absorption effect is compared and analysed. In this study, variations of parametric values are predetermined as Q are 0 and 1.5, α are 0.4, 0.6 and 0.8, M are 0.5, 1.0 and 1.5, $\Pr$ are 0.3, 0.71 and 1.0, and Sc are 0.1, 0.22, 0.6 and 0.78. These values were refered from various literature [8-9], [22-23] on boundary layer of Casson fluid flow and radiation absorption effect.

Table 2. Validation of results with Ali et al. [22]

y	Present Solutions Equations (18)-(20)	Published Solutions [22]
0	1.000	1.0000
2	1.9970	1.9970
4	0.8310	0.8310
6	0.2810	0.2810
8	0.08800	0.08800
10	0.02700	0.02700
12	0.008032	0.008032
14	0.002369	0.002369
16	0.0006910	0.0006910
18	0.0001996	0.0001996
20	0.00005711	0.00005711

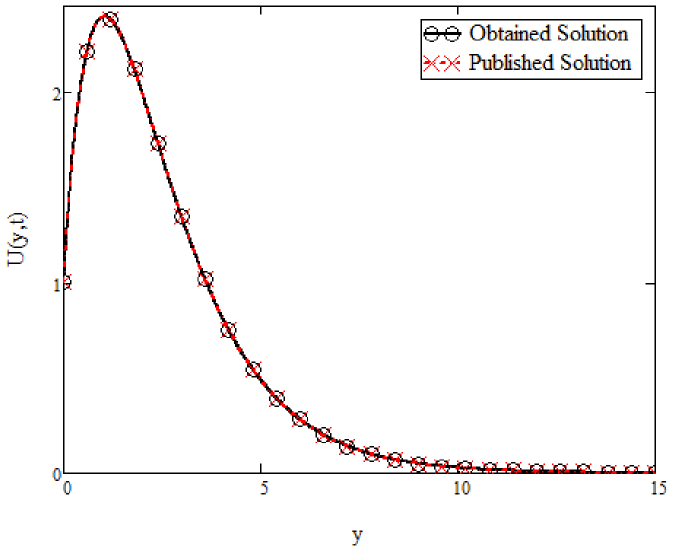

Figure 1. Validation of results with Ali *et al.* [22]

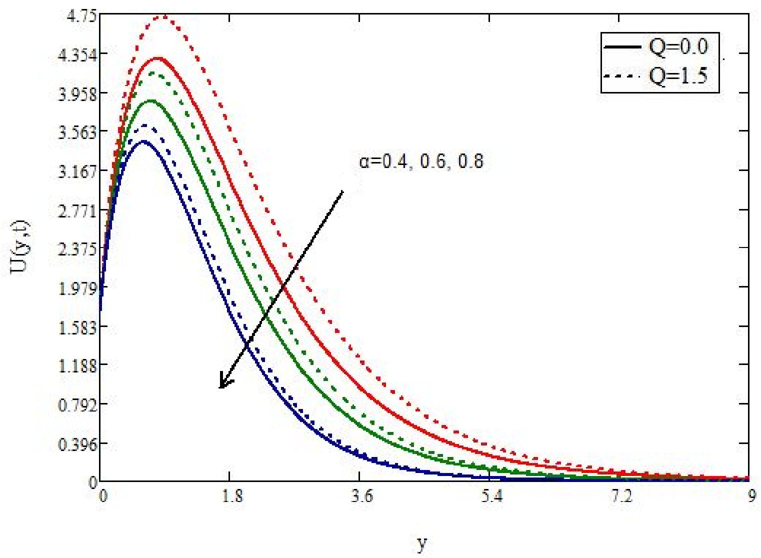

Figure 2. Effect of Q on velocity profile with different values of α .

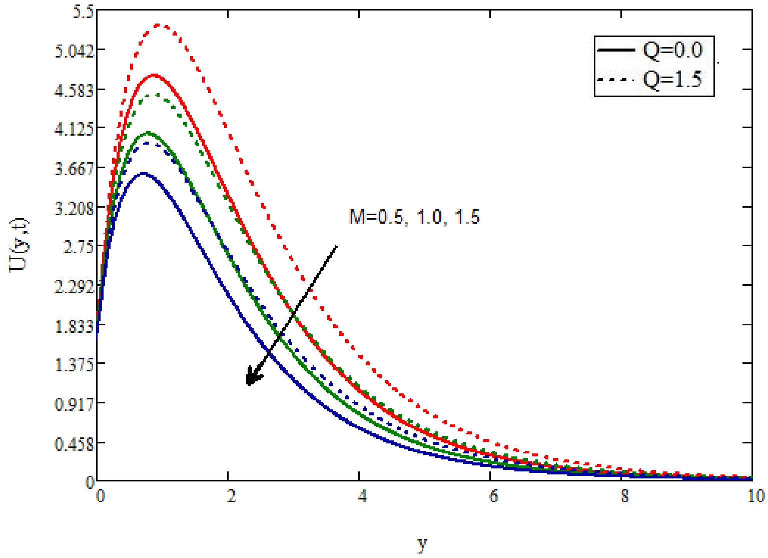

Figure 3. Effect of Q on velocity profile with different values of M .

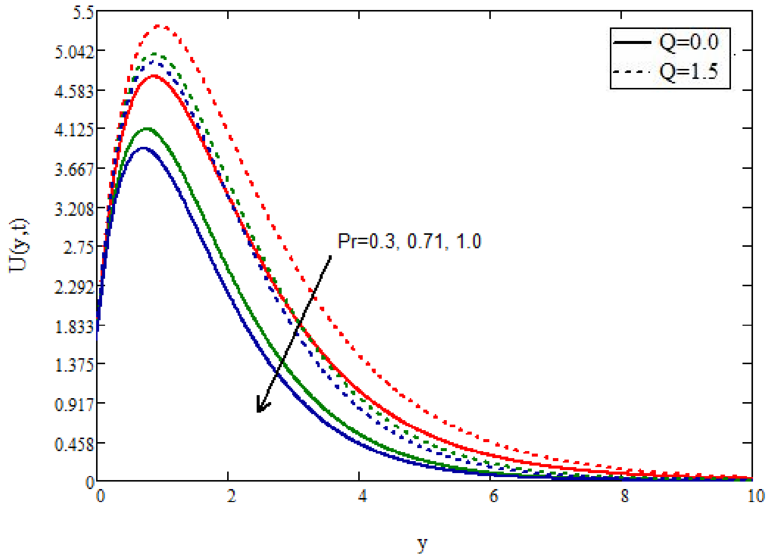

Figure 4. Effect of Q on velocity profile with different values of Pr .

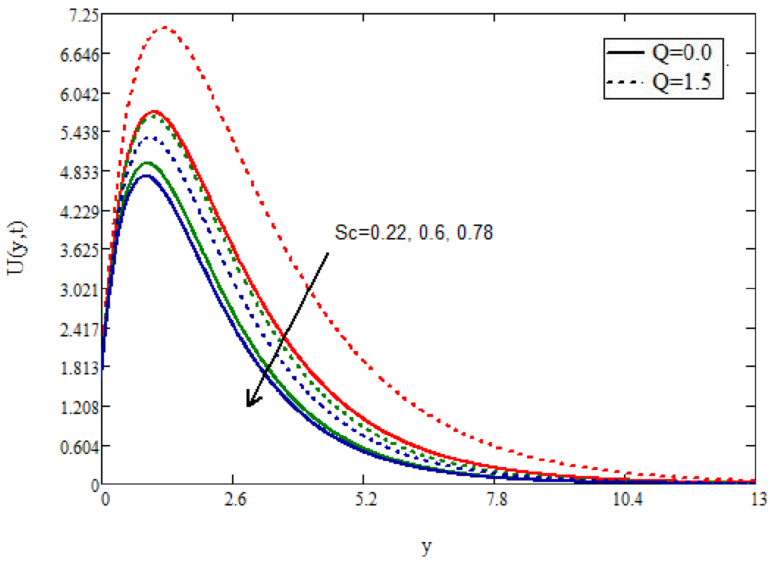

Figure 5. Effect of Q on velocity profile with different values of Sc .

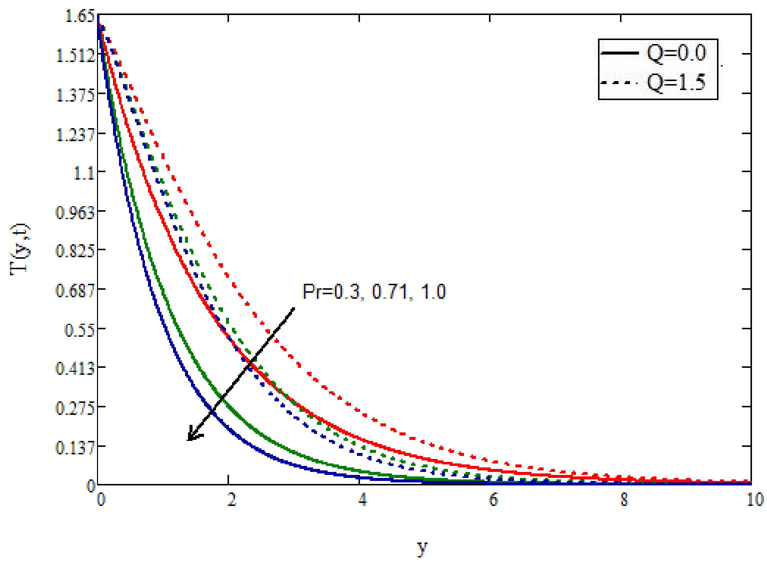

Figure 6. Effect of Q on temperature profile with different values of Pr .

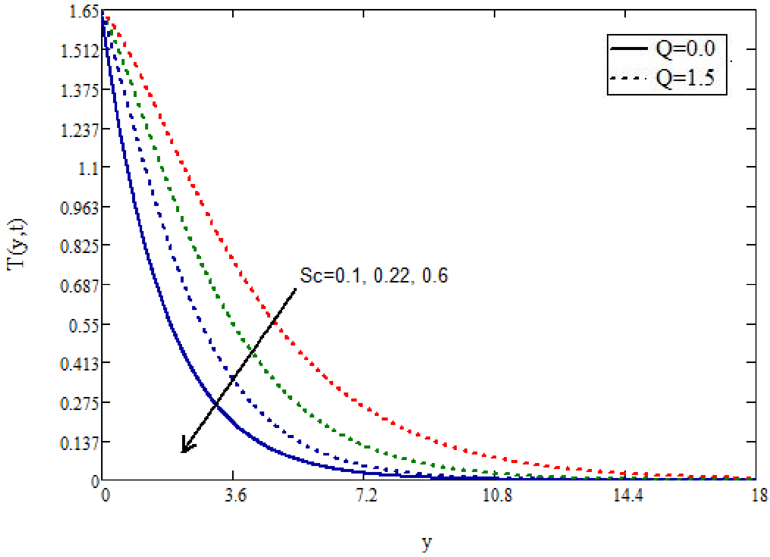

Figure 7. Effect of Q on temperature profile with different values of Sc .

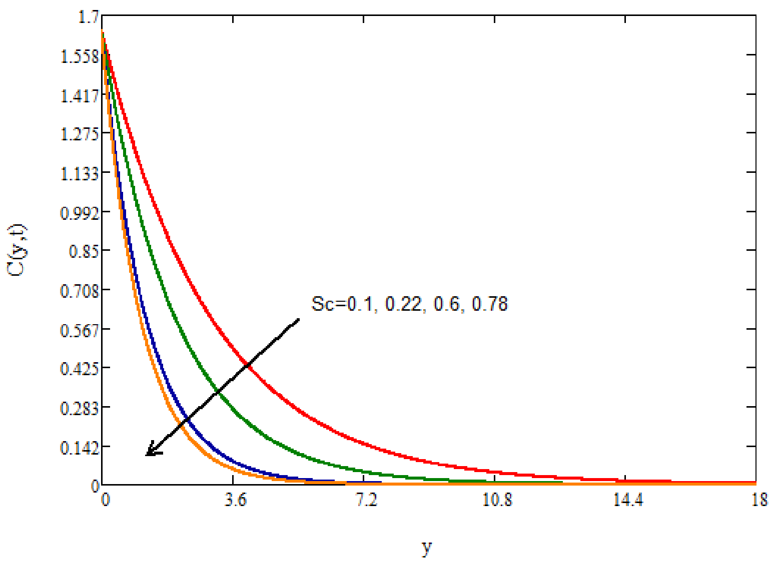

Figure 8. Concentration profile with different values of Sc .

It is observed in Figure 1, that the current results are in agreement with that of Ali *et al.* [22]. Final solutions obtained with limiting cases are compared with the solutions of Ali *et al.* [22] with limiting cases and both solutions are aligned with each other. Validation of current results is sustained further with comparison of numerical values for velocity of fluid with published results from Ali *et al.* [22] as observed in table 2. Thus, the obtained solution is accepted.

Figure 2 depicts the impact of radiation absorption on the velocity of a fluid with varying values α. It is observed that as α increases, fluid velocity decreases. Due to the memory effects of fractional derivatives, varying values α would affect fluid velocity. It will display the behaviour of fluid transitioning from an unsteady state to a steady state. Thus, figure 2 observes the transitioning of fluid velocity. It is also observed that when radiation absorption is considered, fluid velocity tends to increase. The presence of radiation absorption increases temperature gradient by raising the kinetic energy in the fluid. Thus, increasing the fluid velocity.

Effects of radiation absorption on the fluid velocity with varying magnetic field parameter values are observed in Figure 3. Fluid velocity decreases with an increase in M. As the magnetic field parameter gets higher, the magnetic force gets stronger. In turn, it increases the drag force of fluid. Hence velocity of fluid decreases. It also observes that the fluid velocity would increase in the presence of radiation absorption.

Meanwhile, a decrease in fluid velocity is seen with an increase in the Prandtl number is observed in Figure 4. Increasing the Prandtl value would increase the thermal diffusivity of fluid, decreasing the temperature gradient. Hence velocity of fluid decreases due to loss in thermal kinetic energy. Again, with varying values of Pr, fluid velocity increases slightly in the presence of radiation absorption.

Figure 5 shows behaviour of fluid with variations in Schmidt number, *Sc*. It is inditated from figure 5 that a decrease in fluid velocity is observed with an increment in Schmidt number. Shmidt number is defined as the ratio between kinematic viscosity and molecular diffusion. Molecular diffusion tends to decrease with an increase in Schmidt number, hence slowing down fluid movement. It can also be seen that with the presence of radiation absorption, the fluid velocity with varying values of Schmidt number would increase.

Figures 6 and 7 displays the effects of radiation absorption on the temperature profile of fluid with varying values of Prandtl number and Schmidt number. The temperature profile observes a decreasing trend with an increase in both the Prandtl number and Schmidt number. With the presence of radiation absorption, the fluid temperature increases, as shown in Figure 6. Meanwhile, in Figure 7, it is apparent that varying Schmidt number can only be analysed with radiation absorption. It is caused by the fact that the Schmidt number only exists in the energy equation via radiation absorption. Hence without presence of radiation absorption, varying Schmidt number for tempertaure profile cannot be analysed.

Lastyly, Figure 8 shows the concentration profile with different values of *Sc.* It is observed that concentration profile decreases as values of *Sc* increases. This is because, the increase of the values of Sc increases the viscous force that acts in fluid flow, hence reducing the concentration of the fluid flow.

CONCLUSION

The present study investigates the effect of radiation absorption on an unsteady Caputo fractional MHD fluid flow over an exponentially accelerated plate. Based on the findings, it can be concluded that:

I. Obtained solutions are in agreement with published results.
II. Fluid velocity increases in the presence of radiation absorption.
III. Fluid temperature increases in the presence of radiation absorption.
IV. An increase in α, M, Pr and Sc would decrease the velocity of the fluid.
V. An increase in Pr and Sc would decrease fluid temperature.
VI. In the absence of radiation absorption, varying Sc values for temperature profile cannot be analysed.

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