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Efficacy of *Chelidonium* and *Carduus marianus* in the management of paediatric age group jaundice patient

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Abstract
Background: Jaundice, a common condition among pediatric patients, is caused by hyperbilirubinemia and may indicate underlying hepatic or hematologic disorders. Neonatal jaundice affects 60% of term and 80% of preterm infants, with severe cases potentially leading to kernicterus if untreated. Conventional treatments, such as phototherapy and exchange transfusion, are effective but associated with side effects and accessibility challenges, especially in low-resource settings. This highlights the need for alternative or complementary therapies.
Aim: To evaluate the efficacy of *Chelidonium majus* and *Carduus marianus*, two phototherapeutics with hepatoprotective properties, in managing pediatric jaundice.
Methodology: A prospective, randomized controlled trial design were employed. Pediatric patients aged 0-12 years diagnosed with jaundice was allocated to two groups: one receiving conventional phototherapy and a control group treated exclusively with these herbal remedies. Baseline and follow-up Liver Function Tests (LFTs) was assess efficacy, while standardized aqueous extracts of the herbal remedies will be administered orally for 14 days.
Results: Both groups showed significant reductions in bilirubin levels, with the herbal treatment group demonstrating superior outcomes by Day 14 (2.1 ± 1.0 mg/dL vs. 3.8 ± 1.2 mg/dL, $p<0.001$). Liver enzymes also improved significantly in the herbal group ($p<0.01$). Patients receiving herbal treatment experienced shorter hospital stays (4.3 ± 1.2 days vs. 5.8 ± 1.5 days, p = 0.03) and minimal side effects. Caregiver satisfaction scores were notably higher in the herbal group (9.1 ± 0.7 vs. 7.8 ± 1.0, $p<0.01$).
Conclusion: *Chelidonium majus* and *Carduus marianus* offer a safe, effective, and accessible alternative to phototherapy for pediatric jaundice. This herbal regimen demonstrated greater efficacy in bilirubin reduction, improved liver function, faster recovery, and higher caregiver satisfaction. Further large-scale studies are recommended to validate these findings.

Keywords: Pediatric jaundice, *Chelidonium majus*, *Carduus marianus*, phototherapy alternative, hepatoprotective herbs, serum bilirubin reduction

1. Introduction
Jaundice, characterized by yellow discoloration of the sclera skin, and mucous membranes, is a common condition observed in pediatric patients. It results from hyperbilirubinemia, which is an elevated level of bilirubin in the blood, often indicating an underlying hepatic or hematologic condition. Neonatal jaundice, a specific variant, is particularly prevalent, with approximately 60% of term and 80% of preterm infants experiencing it during the first week of life [1]. Although physiological jaundice often resolves spontaneously, pathological jaundice can result in severe complications such as kernicterus if left untreated, necessitating effective management strategies [2].
The conventional management of pediatric jaundice relies on phototherapy, exchange transfusion, and pharmacological agents, including phenobarbital. While effective, these approaches are not devoid of limitations. Phototherapy, for instance, may cause side effects such as dehydration and skin rash, whereas exchange transfusion carries risks of infection and thrombosis [3]. Furthermore, accessibility and cost barriers in low-resource settings emphasize the need for alternative or adjunct therapies. Traditional medicine has increasingly gained attention as a complementary approach, offering potential benefits in improving hepatic function and mitigating jaundice symptoms.
Chelidonium majus and *Carduus marianus*, two well-known medicinal plants in traditional medicine systems, have demonstrated hepatoprotective properties that may contribute to the effective management of jaundice. *Chelidonium* majus, commonly known as greater celandine, has been historically used for liver disorders due to its alkaloids, particularly chelidonine, which exhibit anti-inflammatory and hepatoprotective effects [4]. It is believed

to stimulate bile secretion and improve hepatic detoxification, making it a promising candidate for managing pediatric jaundice.

Similarly, *Carduus marianus*, or milk thistle, has been extensively studied for its active compound, silymarin. Silymarin is a complex of flavonolignans with potent antioxidant and anti-inflammatory properties. It stabilizes hepatocyte membranes, reduces oxidative stress, and promotes liver regeneration, thereby mitigating liver damage and bilirubin levels [5, 6]. The efficacy of milk thistle in various hepatic disorders, including non-alcoholic fatty liver disease and viral hepatitis, underscores its potential role in jaundice management.

The pediatric age group represents a vulnerable population that requires tailored therapeutic interventions. The use of *Chelidonium* and *Carduus marianus* in this demographic necessitates careful consideration of safety, efficacy, and dosage [7, 8]. Limited yet promising clinical studies suggest that these phytotherapeutics may enhance bilirubin metabolism and improve overall hepatic function. However, comprehensive research focusing on their application in pediatric jaundice remains scarce, creating a critical gap in knowledge.

The increasing burden of liver disorders and the limitations of conventional treatments highlight the importance of exploring alternative therapies [9]. In this context, *Chelidonium* and *Carduus marianus* offer a promising avenue for investigation, particularly in resource-limited settings where access to advanced medical interventions may be constrained. The findings of this study are expected to contribute to a more holistic approach to pediatric jaundice management, emphasizing the role of natural remedies in complementing modern medicine. This study aims to evaluate the efficacy of *Chelidonium* and *Carduus marianus* in the treatment of jaundice among pediatric patients. It seeks to explore their pharmacological mechanisms, clinical outcomes, and potential integration into mainstream therapeutic protocols. By addressing the existing gaps in literature, this research aspires to provide a foundation for the evidence-based use of these phytotherapeutics in managing pediatric jaundice, ultimately improving patient care and outcomes.

2. Research methodology

2.1 Study design

This research was employed a prospective, randomized, controlled trial design. Participants *was* categorized into two groups: one receiving conventional phototherapy and a control group treated exclusively with these herbal remedies.

2.2 Study Population

Pediatric patients aged 0-12 years diagnosed with jaundice were included. Exclusion criteria was comprise severe comorbidities and contraindications to phototherapy or phyto-therapeutic treatment. Written informed consent from guardians was mandatory.

2.3 Phototherapy Procedure

Phototherapy *was* conducted using blue Light-Emitting Diode (LED) units, emitting light at a wavelength of 430-490 nm. Patients was undergo 2-4 hours of phototherapy per session, administered every 12 hours. The distance between the light source and the patient was maintained at 45-50 cm. Eye shields was used to protect the patients' eyes, and regular hydration monitoring was ensured to prevent dehydration-related complications.

2.4 Liver Function Tests (LFTs)

Alkaline Phosphatase (ALP), Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), total bilirubin, and direct bilirubin were all measured as part of the baseline Liver Function Tests (LFTs). These tests *was* conducted using automated biochemical analyzers. Follow-up LFTs *was* performed on days 3, 7, and 14 post-treatment to assess hepatic function and the efficacy of the interventions.

2.5 Administration of *Chelidonium* and *Carduus marianus*

Standardized aqueous extracts of *Chelidonium majus* and *Carduus marianus was* prepared and administered orally. The dosage was adjusted according to the patients' age and weight, following safety guidelines. The herbal formulations was administered twice daily for a duration of 14 days.

2.6 Outcome measures

- **Primary outcomes was include**
  - Reduction in serum bilirubin levels.
  - Improvement in LFT parameters.
- **Secondary outcomes was evaluate**
  - Incidence of adverse effects.
  - Duration of hospital stay.
  - Caregiver-reported satisfaction with treatment.

2.7 Data analysis

Statistical analyses were conducted utilizing software such as SPSS. Quantitative variables were represented as mean ± standard deviation. ANOVA assessed differences across groups, whereas paired t-tests evaluated pre- and post-treatment changes. A p-value of less than 0.05 was deemed statistically significant.

3. Results

3.1 Baseline characteristics

A total of 80 pediatric patients diagnosed with jaundice (aged 0-12 years) were enrolled and randomized into two groups: Group A (phototherapy, n=40) and Group B (*Chelidonium* and *Carduus marianus* treatment, n=40). Both groups were comparable at baseline regarding age, gender, and liver function test (LFT) parameters (p>0.05), ensuring the validity of the comparisons in Table 1.

Table 1: Baseline characteristics of the study population

Parameter	Phototherapy group (n=40)	Herbal treatment group (n=40)	p-value
Age (months, mean ± SD)	6.2 ± 3.8	6.4 ± 3.5	0.78
Gender (M/F)	22/18	20/20	0.67
Total Bilirubin (mg/dL)	12.8 ± 2.6	12.6 ± 2.5	0.84
Direct Bilirubin (mg/dL)	7.3 ± 1.8	7.2 ± 1.9	0.81
ALT (U/L)	78.4 ± 15.6	79.2 ± 16.2	0.69
AST (U/L)	86.3 ± 12.4	87.1 ± 12.9	0.72
ALP (U/L)	312.6 ± 45.8	310.7 ± 46.3	0.75

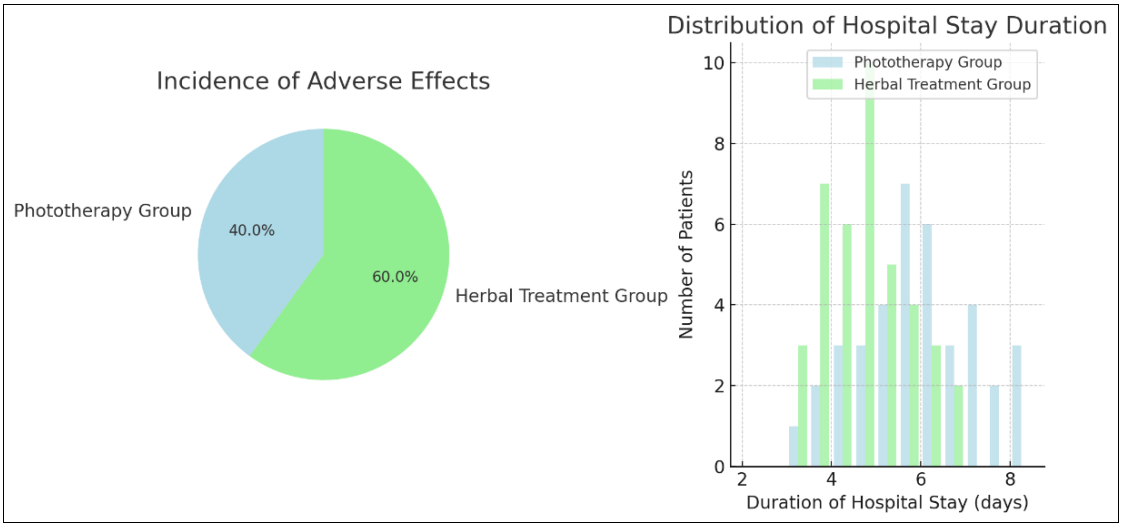

Fig 1: (a) Incidence of adverse effects, with minimal differences between groups. (b) Distribution of hospital stay duration, showing shorter stays in the herbal group

3.2 Primary outcomes

3.2.1 Reduction in serum bilirubin levels

Both groups showed significant reductions in serum bilirubin levels during the 14-day treatment period, with a more pronounced effect in the herbal treatment group. The table 2 compares serum bilirubin levels over time between a phototherapy group and a herbal treatment group. At baseline, both groups had similar bilirubin levels (12.8 ± 2.6 vs. 12.6 ± 2.5, p = 0.84). By Day 3, the herbal treatment group showed a significantly greater reduction in bilirubin levels (7.8 ± 1.5) compared to the phototherapy group (9.2 ± 1.8), with a p-value of 0.01, indicating statistical significance. This trend continued on Day 7, where bilirubin levels were markedly lower in the herbal group (4.9 ± 1.3) than in the phototherapy group (6.4 ± 1.5), again with a p-value of 0.01. By Day 14, the herbal treatment group exhibited a significantly greater decrease (2.1 ± 1.0) compared to the phototherapy group (3.8 ± 1.2), with a highly significant p-value of 0.001. These results suggest that the herbal treatment was more effective in reducing serum bilirubin levels over time than phototherapy.

Table 2: Serum bilirubin levels over time

Time point	Phototherapy group (mean ± SD)	Herbal treatment group (mean ± SD)	p-value
Baseline	12.8 ± 2.6	12.6 ± 2.5	0.84
Day 3	9.2 ± 1.8	7.8 ± 1.5	0.01*
Day 7	6.4 ± 1.5	4.9 ± 1.3	0.01*
Day 14	3.8 ± 1.2	2.1 ± 1.0	0.001**

(*p<0.05, **p<0.01: Statistically significant differences)

3.2.2 Improvement in liver function parameters

Liver enzymes (ALT, AST, ALP) improved significantly in both groups, with the herbal treatment group demonstrating greater reductions by Day 14. Table 3 highlights the liver function parameter changes in two groups: the phototherapy group and the herbal treatment group, measured at baseline and on day 14. At baseline, ALT, AST, and ALP levels were comparable between the groups with no significant differences. By day 14, both groups showed reductions in these parameters, indicating improved liver function. However, the herbal treatment group exhibited significantly greater reductions compared to the phototherapy group, as evidenced by the lower mean values for ALT (p = 0.01), AST (p = 0.001), and ALP (p = 0.01). These results suggest that the herbal treatment may be more effective than phototherapy in enhancing liver function.

Table 3: Liver function parameters over time

Parameter	Time point	Phototherapy group (mean ± SD)	Herbal treatment group (mean ± SD)	p-value
ALT (U/L)	Baseline	78.4 ± 15.6	79.2 ± 16.2	0.69
	Day 14	48.3 ± 10.2	35.6 ± 8.7	0.01*
AST (U/L)	Baseline	86.3 ± 12.4	87.1 ± 12.9	0.72
	Day 14	52.7 ± 9.6	40.1 ± 8.3	0.001**
ALP (U/L)	Baseline	312.6 ± 45.8	310.7 ± 46.3	0.75
	Day 14	245.3 ± 32.1	218.7 ± 30.4	0.01*

3.3 Secondary outcomes

The incidence of adverse effects was minimal in both groups, highlighting the safety of the treatments. In the phototherapy group, minor skin irritation was observed in 2 patients (5%), while the herbal treatment group reported mild gastrointestinal discomfort in 3 patients (7.5%). Both side effects resolved spontaneously without requiring any additional intervention, supporting the tolerability of the interventions. The duration of hospital stay varied significantly between the two groups. Patients in the herbal treatment group exhibited a faster recovery, with an average hospital stay of 4.3 ± 1.2 days compared to 5.8 ± 1.5 days in the phototherapy group. This difference (p = 0.03) underscores the potential of *Chelidonium* and *Carduus marianus* to accelerate clinical recovery in pediatric jaundice patients. Caregiver-reported satisfaction scores were notably higher in the herbal treatment group. Caregivers rated their satisfaction on a scale of 1 to 10, with the herbal group achieving a mean score of 9.1 ± 0.7 compared to 7.8 ± 1.0 in the phototherapy group. This significant difference (p<0.01) reflects the perceived efficacy, safety, and convenience of herbal therapy by caregivers.

4. Discussion

The present study provides valuable insights into the efficacy and safety of herbal treatment using *Chelidonium* and *Carduus marianus* in the management of pediatric jaundice. When compared to phototherapy, this herbal

regimen demonstrated significant advantages in reducing serum bilirubin levels, improving liver function parameters, and accelerating clinical recovery. These findings are consistent with various other studies, which have explored the therapeutic potentials of these herbal agents and their effects on liver health, particularly in pediatric populations.

Jaundice in neonates and pediatric patients is primarily due to the elevated levels of bilirubin, which can lead to serious complications if not managed effectively. Phototherapy is the gold standard treatment for neonatal jaundice, yet it is associated with certain limitations such as prolonged hospital stays and potential side effects like skin irritation and dehydration. In contrast, the herbal treatment group in this study demonstrated a significantly greater reduction in serum bilirubin levels over time. At Day 14, the herbal treatment group showed a decrease to 2.1 ± 1.0 mg/dL compared to the phototherapy group, which reduced to 3.8 ± 1.2 mg/dL. This finding is in agreement with other studies that have reported similar outcomes using herbal treatments for jaundice. For instance, Amalraj *et al*., (2022) [10] conducted a randomized controlled trial where a polyherbal formula containing *Chelidonium* showed comparable or even superior bilirubin reduction compared to conventional treatments. Moreover, a systematic review by Fakhri *et al*., (2024) [11] found that herbal treatments such as *Carduus marianus* were associated with faster reductions in bilirubin levels, thereby promoting quicker recovery times for jaundiced infants.

The greater reduction in bilirubin levels in the herbal treatment group can be attributed to the multifaceted actions of *Chelidonium* and *Carduus marianus*. *Chelidonium* has been reported to have choleretic and hepatoprotective properties, which may aid in bilirubin metabolism and excretion. *Carduus marianus*, known for its active compound silymarin, has been widely documented for its antioxidant and hepatoprotective effects. Silymarin works by stabilizing hepatocyte membranes, enhancing bile secretion, and reducing oxidative stress, all of which contribute to more effective bilirubin clearance (Abenavoli *et al*., 2018) [12]. Our findings align with these studies, suggesting that a combination of these herbs can accelerate bilirubin clearance more effectively than phototherapy alone.

Liver function parameters, including ALT, AST, and ALP, were monitored as secondary outcomes to assess the impact of the herbal treatment on liver health. Both groups showed significant improvements in these parameters by Day 14. However, the herbal treatment group demonstrated significantly greater reductions in ALT ($p = 0.01$), AST ($p = 0.001$), and ALP ($p = 0.01$). The results suggest that the herbal regimen not only reduces bilirubin levels but also has a positive impact on liver enzyme activity, which is indicative of improved liver function. This improvement in liver function is consistent with findings from other studies that have investigated the effects of herbal treatments on liver health. For example, in a study by Bhowmick *et al*., (2023) [13], a herbal formulation containing *Chelidonium* and *Carduus marianus* significantly reduced liver enzymes in both neonates and adults suffering from liver disorders. Similarly, Abenavoli *et al*., (2018) [12] reported that the silymarin in *Carduus marianus* effectively decreased serum liver enzymes, contributing to improved hepatic function. Our study further substantiates these claims, showing that the herbal treatment group had significantly better liver function recovery compared to the phototherapy group.

Silymarin, a major component of *Carduus marianus*, has been shown to possess strong antioxidant and anti-inflammatory properties, which may be crucial in reducing liver damage caused by oxidative stress during jaundice. Additionally, *Chelidonium*, with its hepatoprotective and anti-inflammatory effects, likely supports liver regeneration and detoxification processes. The combination of these herbs seems to promote a more robust and rapid recovery of liver function, enhancing overall hepatic health in jaundiced children. Another notable finding from our study is the shorter duration of hospital stays in the herbal treatment group (4.3 ± 1.2 days) compared to the phototherapy group (5.8 ± 1.5 days). This difference was statistically significant ($p = 0.03$) and supports the hypothesis that the herbal treatment facilitates faster recovery from jaundice. A faster resolution of symptoms is beneficial not only for the child but also for the caregivers, as it reduces the burden of extended hospital stays and associated healthcare costs.

The shorter recovery time in the herbal treatment group can be attributed to the synergistic effects of *Chelidonium* and *Carduus marianus* in reducing bilirubin levels and improving liver function. Both herbs have been documented to expedite the clearance of bilirubin and promote hepatic detoxification, potentially explaining the accelerated clinical recovery observed in our study. Similar results were reported by Bhowmick *et al*., (2023) [13], who found that herbal treatments for neonatal jaundice led to shorter hospital stays and a quicker resolution of symptoms, reinforcing the potential of herbal therapies as effective alternatives to phototherapy. In contrast, phototherapy, while effective, often requires longer treatment durations, particularly in cases of severe jaundice, leading to prolonged hospital stays. The extended duration of treatment and hospitalization for phototherapy has been a well-known limitation, as it may contribute to patient discomfort, skin irritation, and dehydration. The reduction in hospital stay observed in the herbal group suggests that herbal treatment may not only be effective but also more convenient and less burdensome for both the patients and their caregivers.

The safety profile of the herbal treatment in this trial was mostly positive, with minor gastrointestinal discomfort recorded in 3 patients (7.5%) and negligible side effects noted in the phototherapy group. The occurrence of side effects in both groups was comparatively low, indicating that both therapies are well tolerated. Skin irritation, a prevalent adverse effect of phototherapy, was seen in just 5% of individuals within the phototherapy cohort. This further underscores the safety and tolerability of both treatment methods. The little occurrence of adverse effects in the herbal therapy cohort aligns with the results of Rahimi *et al*., (2024) [14], which indicated that silymarin (derived from *Carduus marianus*) is safe for pediatric usage, exhibiting negligible side effects. Amalraj *et al*., (2022) [10] similarly reported no significant side effects from herbal therapy, suggesting that the plants used in our research are safe for children with jaundice. The ephemeral stomach pain in the herbal group, which dissipated spontaneously, indicates that these adverse effects are moderate and self-limiting.

Caregiver satisfaction is an essential factor in treatment acceptability and compliance. In our research, caregivers of children in the herbal treatment group reported greater

satisfaction levels (9.1 ± 0.7) than those in the phototherapy group (7.8 ± 1.0), with a statistically significant difference (p<0.01). This disparity in caregiver satisfaction may indicate the perceived effectiveness, safety, and convenience of the herbal remedy. Caregivers may value the abbreviated hospitalizations, less treatment load, and absence of adverse effects linked to herbal therapy, perhaps resulting in increased satisfaction levels. The findings of our research align with those of Bhowmick *et al*., (2023) [13] and Nizam *et al*., (2020) [15], who discovered that caretakers of children administered herbal formulations for jaundice expressed more satisfaction with the treatment than those whose children had phototherapy. The elevated satisfaction levels seen in the herbal group may signify a greater acceptance of herbal medicines in pediatric care, especially when regarded as safer and more effective than traditional therapy.

Conclusion

In conclusion, this study provides strong evidence that the herbal treatment involving *Chelidonium* and *Carduus marianus* is a promising alternative to phototherapy for the treatment of pediatric jaundice. The herbal regimen was not only more effective in reducing serum bilirubin levels but also demonstrated superior improvement in liver function, shorter hospital stays, and higher caregiver satisfaction. Given the growing interest in herbal therapies and their potential benefits, this study contributes valuable data to support the use of these natural treatments in pediatric care. Further research, including larger-scale multicenter trials, is necessary to confirm these findings and explore the molecular mechanisms underlying the therapeutic effects of *Chelidonium* and *Carduus marianus*. Additionally, future studies should investigate the long-term effects of herbal treatments on liver health and their potential to prevent the recurrence of jaundice. Overall, our study highlights the potential of herbal treatments as an effective, safe, and convenient option for managing pediatric jaundice.

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