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RESEARCH ARTICLE

Impact of Organic Foods and Herbal Interventions on Key Biochemical Parameters in Patients with Stage IV Chronic Kidney Disease Over a 9-Month Period

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Abstract

Objective: The aim of the present study was to evaluate the effectiveness of an organic dietary and herbal intervention in improving renal biochemical parameters and maintaining electrolyte homeostasis in patients with Stage IV Chronic Kidney Disease (CKD).

Materials and Methods: A prospective, observational, longitudinal cohort study was conducted over nine months, from January to September 2024, at the Rehman Diagnostic and Research Centre, Lahore, Pakistan. A total of 100 patients with Stage IV CKD [estimated glomerular filtration rate (eGFR), 15-29 mL/min/1.73 m^2] received standard CKD care in combination with an organic renal meal pack formulated to provide low levels of protein, sodium, phosphorus and potassium, while providing high levels of dietary fibre and antioxidants. Biochemical parameters, including serum creatinine, urea, calcium and potassium, were assessed monthly throughout the study period. Data were analysed using repeated-measures analysis of variance (ANOVA), with $p<0.05$ considered statistically significant.

Results: Mean serum creatinine and urea concentrations decreased significantly over the study period, from 4.0 to 3.0 mg/dL and from 120 to 60-80 mg/dL, respectively ($p<0.001$). Serum potassium levels gradually decreased from 6.0 to 4.7 mEq/L, although this change was not statistically significant ($p>0.05$). In contrast, serum calcium levels increased from 6.2 to 8.8 mg/dL, indicating improvement in mineral balance. No adverse effects related to the intervention were reported, suggesting that the dietary and herbal meal pack was well tolerated.

Conclusion: The organic dietary and herbal intervention was associated with significant improvements in serum creatinine and urea levels and appeared to support electrolyte and mineral homeostasis in patients with Stage IV CKD. These findings suggest a potential complementary role for structured organic dietary and herbal interventions alongside standard CKD care. Further controlled studies are warranted to determine the independent effects of the intervention and investigate the potential mechanistic roles of herbal bioactive compounds in oxidative stress, mitochondrial function and renal protection.

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INTRODUCTION

One major public health issue of the twenty-first century is Chronic Kidney Disease (CKD), a serious condition that poses a substantial threat to human health. It is highly prevalent and associated with considerable healthcare costs[1]. CKD is frequently complicated by cardiovascular disease and consequently contributes to high rates of mortality and disability[2]. It is defined by a persistent decline in glomerular filtration rate or the presence of abnormalities in the structure or function of the kidneys[3]. According to current international guidelines, CKD is defined as evidence of kidney damage or a glomerular filtration rate (GFR) of less than 60 ml/min/1.73 m^2 that persists for at least three months[4]. CKD is associated with a markedly increased risk of hospitalization, cardiovascular disease-related morbidity and mortality, as well as additional complications, including acute kidney injury, progression of kidney disease, cognitive decline, anaemia, mineral and bone disorders and fractures[5]. In developing countries such as Pakistan, the prevalence of CKD ranges from 12.5-29.9%, indicating a substantial public health burden[6]. This highlights the urgent need for targeted interventions and improved access to healthcare in these settings. Given that Pakistan's population is expected to increase from 207-330 million by 2030, the burden of CKD is expected to increase substantially[7].

As CKD progresses, it may lead to end-stage renal disease, which requires costly treatments such as hemodialysis, peritoneal dialysis, or kidney transplantation. Globally, the number of individuals requiring dialysis is increasing. In 2010, approximately 2.62 million individuals required dialysis and this number was projected to double by 2030[8]. The CKD often remains undetected until the onset of advanced symptoms, such as kidney failure[9]. This late diagnosis highlights the urgent need for alternative and preventive strategies for CKD management. A growing body of evidence supports the potential role of organic diets in slowing CKD progression. Herbal and dietary supplements are widely used globally, with more than 75% of people in some Asian countries relying on herbal medicine[10]. Over the past decade, research in this field has expanded, with many Asian countries establishing dedicated institutions for herbal medicine research.

Herbal supplements are frequently considered a means of reducing symptoms, enhancing immunity and improving mental and physical health among individuals with chronic conditions such as diabetes, cancer, or HIV, as well as patients recovering from treatments such as organ transplantation[11-14]. In diabetic nephropathy models, herbal formulations such as Bu-Shen-Huo-Xue, Tang Shen and Yiqi Jiedu Huayu have demonstrated improvements in renal function by targeting key signalling pathways, including Rac1/PAK1/p38 MAPK, TXNIP-NLRP3-GSDMD and mTOR via PI3K/Akt and AMPK[15]. Many herbal medicines are believed to cause fewer side effects and may be more suitable for long-term use. Research has demonstrated the therapeutic potential of various herbs in protecting renal function, reducing inflammation and potentially delaying the need for dialysis[15,16]. These treatments, rooted in traditional medicine, continue to be investigated and supported by modern research and technological advances, offering promising directions for integrative approaches to CKD management. This study was designed to evaluate the effectiveness of an organic meal pack in delaying the initiation of dialysis among patients with CKD by assessing its effects on renal function and metabolic parameters.

MATERIALS AND METHODS

Study design and participants: This study was designed as a prospective, observational, longitudinal cohort investigation conducted over seven months, from January 1st, 2024, to September 30th, 2024, to evaluate the effectiveness of an organic dietary intervention in delaying progression to dialysis among patients with CKD. A total of 100 patients diagnosed with Stage IV CKD, confirmed by a standardized estimated glomerular filtration rate (eGFR) of 15-29 mL/min/1.73 m^2, were enrolled in the study. Participants were recruited from the Rehman Diagnostic and Research Centre, Lahore, Pakistan, after fulfilling the inclusion criteria and providing written informed consent. Baseline demographic, clinical and biochemical parameters were recorded at enrolment and monitored throughout the study period to assess changes associated with the dietary intervention. The key parameters evaluated in this study included renal function markers (serum creatinine and blood urea), biochemical parameters (serum electrolytes) and dietary assessments, such as daily protein and calorie intake.

Inclusion and exclusion criteria: Patients were recruited from the Nephrology Department of the Rehman Diagnostic and Research Centre, Lahore, based on a confirmed clinical diagnosis of Stage IV CKD, verified through previous biochemical reports and consultation notes. Participants aged 30-60 years, including both male and female patients, with a baseline haemoglobin (Hb) level greater than 7 g/dL, were included in the study. Patients diagnosed with CKD Stages II, III, or V were excluded to maintain cohort uniformity. Individuals with a history of kidney stones, those who received blood transfusions during the study period, or those undergoing renal dialysis were also excluded.

Intervention: All enrolled patients received standard CKD management, including blood pressure control and lifestyle counselling. In addition, each participant was provided with a structured organic renal meal pack specifically formulated to meet the nutritional needs of patients with Stage IV CKD. The herbal components were boiled for 10 minutes as part of a standardized protocol to reduce anti-nutritional factors, including lectins, protease inhibitors, phytohaemagglutinin and phytic acid. Laboratory analysis confirmed that these compounds were effectively reduced following boiling. The meal pack was supplied to patients along with a specific dietary plan (Table 1). The dietary intervention emphasized low protein intake (0.6-0.8 g/kg/day), reduced sodium, phosphorus and potassium levels and a high dietary fibre and antioxidant content.

Statistical analysis: Statistical analysis included analysis of variance (ANOVA) was performed to compare baseline and post-intervention renal parameters. Descriptive statistics were used to summarize changes in key biomarkers and Tukey's honestly significant difference (HSD) test was employed for post-hoc comparisons. A $p<0.05$ was considered statistically significant.

RESULTS

Serum creatinine levels: A consistent decline in mean serum creatinine levels was observed, from 4.0 mg/dL in January to approximately 3.0 mg/dL in September, indicating a gradual improvement in renal function over the study period (Fig. 1). Statistical analysis using repeated-measures ANOVA revealed that the month-to-month variations in serum creatinine levels were statistically significant ($p<0.001$), indicating a significant temporal effect associated with the dietary and clinical management interventions. This downward trend suggests a favourable renal response among participants and supports the potential benefits of organic dietary modification in managing CKD progression.

Figure 1 shows a gradual decline in mean serum creatinine levels over the 9-month study period, indicating improved renal function and a favourable response to clinical management and therapeutic interventions. The standard deviation was ±0.5 mg/dL.

Serum urea trend: A marked decline in mean serum urea levels was observed, from approximately 120 mg/dL in January to 60 mg/dL in April, followed by slight fluctuations between 60 and 80 mg/dL from May to September. Statistical

Table 1: Dietary guidelines for kidney disease management

Category	Details
Dietary restrictions	Red meat, okra, eggplant, taro root, spinach, leafy greens, peas, raw tomatoes, chickpeas and mung beans, bananas, oranges, grapefruits, loquats, black plum, chicken, layered flatbread, jam, jelly butter, rice pudding, sour and acidic items, peanuts, sweet potatoes, potatoes, water chestnuts, cold drinks, cold water, ice, milk and yogurt, etc
Recommended foods	Egg white slices, Indian gooseberry, carrot or apple jam, cornflakes or oatmeal, barley or wheat porridge, sago pudding, milk tea Goat meat broth, chicken broth, black chickpea broth, fish, Green Gram Beans, turnips, bottle gourd, sweet gourd, ridge gourd, cauliflower, apple gourd, Radish pods, Mountain Ebony, salad
Fruits allowed	Apple, guava, pear, melon, peach, apricot, cherry, sweet grapes, sweet pomegranate, mango, papaya
Medicinal herbs (capsule form)	Boswellia serrata (API), Tinospora cordifolia (API), Rheum officinale (Eu.Ph), Citrullus colocynthis (API), Elettaria cardamomum (seed) (API), Curcuma longa Linn (API), Oryza sativa Linn (API), Daucus carota Linn (UPI)

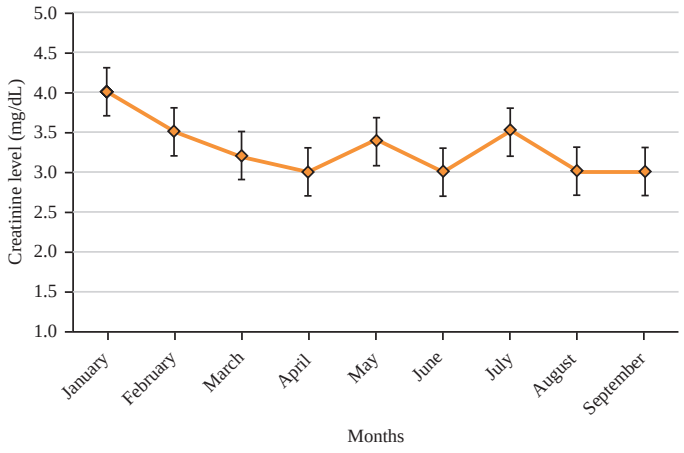

Fig. 1: Temporal trend in mean serum creatinine levels (mg/dL) among patients from January to September

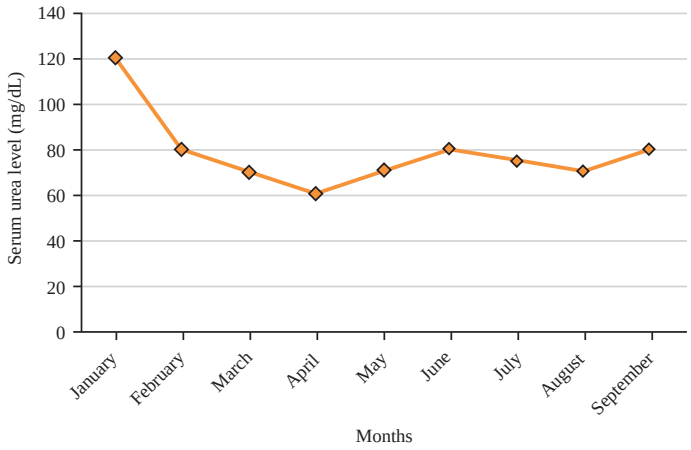

Fig. 2: Temporal trend in mean serum urea levels (mg/dL) among CKD patients from January to September 2024

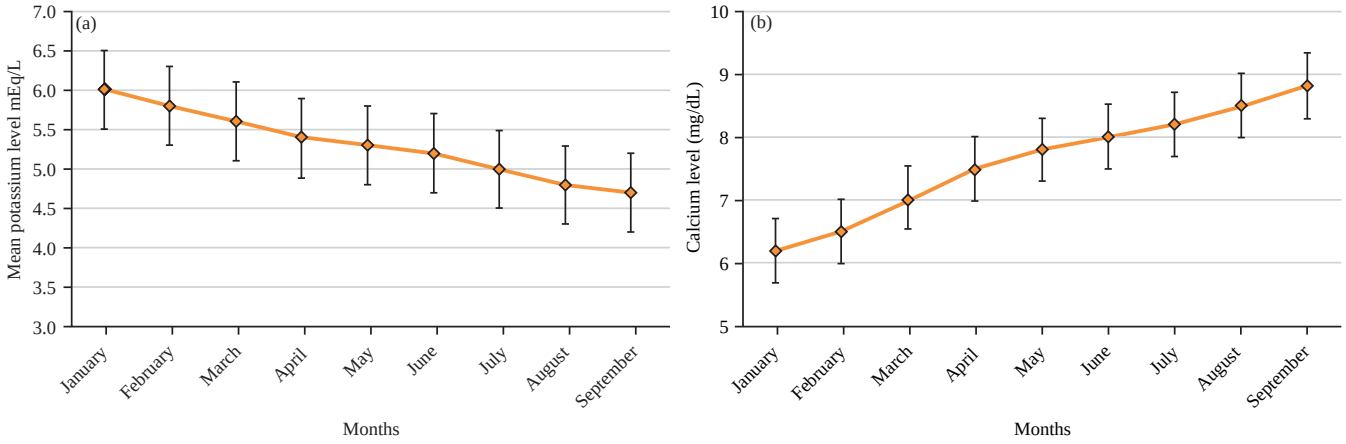

Fig. 3(a-b): (a) Temporal trend in mean serum potassium levels (mEq/L) among CKD patients from January to September 2024 and (b) Month-wise trend in mean serum calcium levels (mg/dL) from January to September 2024

analysis using repeated-measures ANOVA indicated that the month-to-month variation in serum urea levels was statistically significant ($p<0.001$), reflecting a significant temporal change in renal biochemical status. The initial sharp reduction suggests a favourable response to the organic dietary intervention and standard CKD management, while the subsequent stabilization phase indicates maintenance of the observed improvement in metabolic control among participants (Fig. 2).

Electrolyte levels: Serum potassium and calcium levels showed improvement throughout the study period, indicating that the dietary intervention did not adversely affect electrolyte balance. Mean serum potassium levels were effectively managed, showing a gradual reduction from a baseline of approximately 6.0-4.7 mEq/L, which was within the target range of 4.5-5.5 mEq/L ($p>0.05$), indicating stability without evidence of hypokalaemia (Fig. 3a). In addition, serum calcium levels increased from 6.2 mg/dL in January to 8.8 mg/dL in September, remaining within the stated range of 6.0-9.0 mg/dL and suggesting improved mineral balance (Fig. 3b). Overall, these findings suggest that the herb-based renal meal pack was well tolerated with respect to electrolyte and mineral homeostasis in patients with CKD.

Figure 3a illustrates a gradual and consistent decline in serum potassium concentration from approximately 6.0 mEq/L to 4.7 mEq/L, indicating improved management of hyperkalaemia during the organic dietary intervention and standard clinical care. Error bars represent standard deviations across monthly measurements.

Figure 3b shows a steady increase in serum calcium levels, from 6.2 mg/dL in January to 8.8 mg/dL in September, suggesting gradual improvement in calcium balance during continued dietary and clinical management.

DISCUSSION

Effective management of CKD requires more than symptom control; a comprehensive approach is necessary to slow disease progression and maintain overall health. Adopting kidney-friendly dietary practices, engaging in regular physical activity and maintaining a healthy body weight are lifestyle modifications that can provide substantial benefits[17]. A kidney-friendly diet helps reduce the accumulation of metabolic waste products and maintain electrolyte balance, both of which are important for preserving kidney function. However, dietary modification alone may be insufficient. Therefore, this study evaluated the effects of herbal therapy combined with a prescribed dietary intervention on renal function over a 9-month period. Biochemical assessments demonstrated a consistent decline in serum urea and creatinine levels ($p<0.05$), suggesting improved renal biochemical status and more effective removal of metabolic waste products. Following administration of the herbal meal pack, dialysis was no longer required among the patients included in this study. This represents one of the major findings of the present investigation. These findings are consistent with other research, including the Henan Rural Cohort Study (2018-2022), which investigated more than 20,000 rural adults and reported similar improvements in indicators of kidney health. The association between herb consumption and CKD was investigated by Yin *et al.*[18], who reported that higher herb consumption was associated with a 4-5% reduction in the risk of CKD and albuminuria.

According to the present study, patients consuming the herbal meal pack exhibited a gradual increase in serum calcium levels from January to September, indicating an improvement in calcium balance. Meanwhile, serum potassium levels showed a steady but controlled decline while remaining within the stated physiological range throughout the study period. These findings suggest that the herbal meal pack supported electrolyte regulation, with an improvement in serum calcium levels without evidence of persistent hyperkalaemia or clinically apparent potassium imbalance. Overall, the intervention appeared to be well tolerated and potentially beneficial for maintaining stable electrolyte profiles in patients with CKD. This finding is clinically relevant because potassium abnormalities, particularly hyperkalaemia, are common complications of CKD. According to a 2019 study by Martínez-Pineda *et al.*[19], soaking and boiling legumes can reduce their potassium concentration by up to 80%. Incorporating these food-preparation techniques into meal planning may allow patients with CKD to consume legumes while better controlling dietary potassium intake. This approach illustrates how appropriately prepared dietary interventions may help support kidney health while maintaining an appropriate balance of essential nutrients.

Research suggests that vegetarian diets may provide several potential benefits for kidney health, including improved gastrointestinal function, reduced production or accumulation of potentially harmful uremic metabolites and improved gut microbial function. These diets may also promote the production of short-chain fatty acids, which may contribute to overall renal health[20,21]. Another potential benefit of plant-based diets is their capacity to reduce dietary acid load and thereby help mitigate metabolic acidosis, an important factor associated with CKD progression. Foods rich in naturally alkalizing compounds may reduce the dietary acid burden and potentially decrease metabolic stress on the kidneys[22]. Vegetarian diets are also generally rich in antioxidant and anti-inflammatory compounds, which may help slow CKD progression by reducing systemic inflammation and oxidative stress[23].

Recent cohort data among patients with both type 2 diabetes and Chronic Kidney Disease (CKD) reinforce the importance of avoiding persistently elevated HbA1c levels. In the Korean Cohort Study for Outcome in Patients With Chronic Kidney Disease (KNOW-CKD), higher time-varying HbA1c categories (7.07.9% and $\geq$8.0%) were associated with adjusted hazard ratios of 1.59 and 1.99, respectively, for a composite outcome of major adverse cardiovascular events or mortality, compared with HbA1c <7.0%[24]. Although, glycaemic lowering per se has demonstrated only modest or inconsistent effects on hard renal outcomes in meta-analyses, such as doubling of serum creatinine or the need for dialysis, observational data continue to associate poor glycaemic control with incident CKD and adverse clinical outcomes[25]. These findings support the approach adopted in this study of maintaining glycaemia toward the upper end of the target range, thereby reducing the risk of hypoglycaemia, which is particularly relevant in the setting of impaired renal clearance, while avoiding the increased mortality signals associated with very intensive glycaemic control in patients with CKD.

In addition to maintaining optimal glycaemic control, cardiovascular and renal protection through appropriate blood pressure management is equally essential in CKD. Control of systemic blood pressure remains a fundamental reno- and cardioprotective strategy in patients with CKD. A

recent meta-analysis of nine randomized controlled trials involving patients with CKD demonstrated that more intensive blood pressure targets, such as systolic blood pressure <130/80 mmHg, tended to reduce all-cause mortality (RR 0.81; 95% CI 0.65-1.00) and cardiovascular events (RR 0.89; 95% CI 0.77-1.03), without increasing the risk of serious renal events[26]. Meanwhile, other systematic reviews indicate that although blood pressure reduction is associated with reduced risk, the optimal target may depend on individual factors, including the degree of albuminuria, baseline GFR and comorbidities. For example, an SBP <120 mmHg may not always be beneficial in patients with advanced CKD or diabetic nephropathy[27]. In the context of the present study, maintaining blood pressure within a low-normal range may have acted synergistically with the herbal dietary intervention and may have helped mitigate further nephron injury by reducing glomerular hypertension and intrarenal stress.

Beyond haemodynamic factors, cellular and molecular mechanisms also play a critical role in CKD progression. An emerging mechanistic concept in CKD pathogenesis is mitochondrial dysfunction within the renal tubular and glomerular compartments. Multiple studies have demonstrated that patients with advanced CKD exhibit lower mitochondrial volume density, reduced mtDNA copy number and increased markers of oxidative stress in skeletal and renal tissues[28]. The review by Zhang *et al.*[29] describes how defects in mitochondrial biogenesis, mitochondrial dynamics (fission and fusion) and mitophagy may promote tubular cell apoptosis, interstitial fibrosis and microvascular loss in CKD. Thus, the concept of a therapeutic strategy "focused on supporting mitochondrial function" is consistent with current mechanistic understanding. Interventions that preserve mitochondrial integrity may potentially slow renal structural damage beyond conventional risk-factor control. In the present study, the herbal meal pack, dietary intervention and associated lifestyle modifications may plausibly influence mitochondrial health through mechanisms such as reduced oxidative stress, improved nutrient and energy metabolism and enhanced cellular resilience. However, these potential mechanisms were not directly assessed in the present study and should therefore be considered hypotheses for future investigation. Mechanistic studies evaluating mitochondrial function, oxidative stress and related cellular pathways are warranted to determine whether these pathways contribute to the observed renal benefits of the intervention.

The risks associated with herbal and organic remedies are not always well defined in the context of kidney health. Although, herbal and organic remedies have been used for thousands of years, research evaluating their effects on renal function and safety remains ongoing. For example, aristolochic acid, a compound found in several traditional Chinese medicinal preparations, has been associated with aristolochic acid nephropathy, a condition characterized by renal fibrosis and an increased risk of urothelial and renal malignancies[30]. In addition to the intrinsic toxicity of certain plants or their constituents, renal injury associated with herbal remedies may also result from microbial contamination, adulteration, inappropriate dosing and interactions with prescription medications. Therefore, ensuring the safety and quality of herbal products is essential. High manufacturing standards, accurate and transparent labelling, rigorous clinical evaluation and stringent quality-control measures are required to minimize potential risks. Although, medicinal plants may have potential as complementary approaches in the management of chronic kidney disease, the available evidence remains limited and further well-designed clinical studies are needed to establish their efficacy, safety, appropriate dosage and long-term effects.

CONCLUSION

The 9-month observational data indicate stabilization and gradual improvement in key renal biomarkers, including blood urea, serum creatinine and electrolytes, among patients receiving the organic dietary intervention and herbal medicine. Both blood urea and serum creatinine levels exhibited statistically and potentially clinically meaningful reductions, suggesting improved renal biochemical status and a potential slowing of CKD progression. Importantly, serum potassium and calcium levels remained within the stated acceptable ranges, suggesting that the intervention was well tolerated and did not adversely affect electrolyte and mineral homeostasis in patients with CKD. This study highlights the potential clinical value of an organic renal meal pack comprising low-protein, low-sodium, low-phosphorus and low-potassium foods, together with high-fibre, antioxidant-rich foods and selected herbs, including *Boswellia serrata*, *Tinospora cordifolia* and *Curcuma longa*, as an adjunct to standard CKD care. Over nine months, the intervention was associated with significant improvements in key renal biomarkers among patients with Stage IV CKD, with serum creatinine decreasing from 4.0 to 3.0 mg/dL and blood urea decreasing from 120 to 60-80 mg/dL ($p<0.001$). Electrolyte balance was maintained, with serum potassium decreasing from 6.0-4.7 mEq/L and serum calcium increasing from 6.2-8.8 mg/dL. The findings suggest a potential role for this intervention in conservative CKD management and nutritional care, particularly in resource-limited South Asian settings.

However, because this was an observational study without a control group, the findings do not establish a causal effect or confirm that dialysis initiation was delayed by the intervention. Further controlled clinical studies are warranted to evaluate its efficacy, safety, cost-effectiveness and potential renoprotective mechanisms, particularly those involving oxidative stress and mitochondrial pathways.

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