American Journal of
Biomedical Science & Research

www.biomedgrid.com
ISSN: 2642-1747

Review Article

Palm Kernel Oil-Derived Medium-Chain Triglycerides and Energy Metabolism: A Systematic Review of Physiological Mechanisms in Fat Oxidation, Ketogenesis, and Appetite Regulation

Loso Judijanto*

IPOSS Jakarta, Indonesia

***Corresponding author:** Loso Judijanto, IPOSS Jakarta, Indonesia.

To Cite This article: *Loso Judijanto*, Palm Kernel Oil-Derived Medium-Chain Triglycerides and Energy Metabolism: A Systematic Review of Physiological Mechanisms in Fat Oxidation, Ketogenesis, and Appetite Regulation. Am J Biomed Sci & Res. 2026 31(4) AJBSR.MS.ID.004069,*

DOI: 10.34297/AJBSR.2026.31.004069

Received: July 03, 2026 **Published:** July 14, 2026

Abstract

Understanding the role of dietary lipids in energy metabolism remains an important area of nutritional research, particularly in relation to Medium-Chain Triglycerides (MCTs), which exhibit distinct metabolic properties compared to long-chain triglycerides. Among natural sources, palm kernel oil represents a relevant source of MCTs, warranting a comprehensive evaluation of its physiological effects within metabolic pathways. The present study aims to provide a systematic synthesis of current research findings on the influence of MCTs sourced from palm kernel oil on energy metabolism, particularly concerning fat oxidation, ketogenesis, and appetite regulation. This research adopts a Systematic Literature Review (SLR) design following a structured PRISMA approach. Scientific articles were collected exclusively from the Scopus database using predefined keyword combinations. The selection process involved identification, screening, eligibility assessment, and inclusion stages, resulting in 38 peer-reviewed studies published between 2019 and 2026. Data were analysed through qualitative synthesis to identify recurring patterns and mechanistic themes. The findings indicate that MCT consumption is associated with increased fat oxidation (8–20%) and elevated thermogenesis (40–60 kcal/day). In addition, MCTs promote ketogenesis, with circulating ketone levels reaching 0.3–1.0 mmol/L under moderate intake conditions. Appetite regulation is also influenced, as reflected by reduced energy intake (5–15%) and modulation of satiety-related hormones. These effects are supported by rapid absorption and preferential hepatic metabolism of MCTs. In conclusion, palm kernel oil-derived MCTs influence energy metabolism through integrated mechanisms involving lipid oxidation, ketone production, and appetite signalling. Future research should emphasise long-term interventions, dose-response relationships, and population-specific analyses to further clarify these metabolic effects.

Keywords

Medium-chain triglycerides, Palm kernel oil, Energy metabolism, Fat oxidation, Ketogenesis

Introduction

The regulation of energy intake, storage, and expenditure in the human body is governed by the essential physiological process known as energy metabolism. It involves a complex interaction of biochemical pathways responsible for converting macronutrients

into usable energy substrates required for cellular function, thermoregulation, and metabolic homeostasis [1]. In recent decades, increasing attention has been directed toward the role of dietary lipids in modulating metabolic efficiency, particularly in relation to fat oxidation, substrate utilization, and hormonal regulation of appetite. The growing prevalence of metabolic disorders has further intensified scientific interest in identifying dietary components that may contribute to improved metabolic flexibility and energy balance through well-characterized physiological mechanisms [2]. Among dietary lipids, triglycerides constitute the primary form of fat consumed in human diets and are typically categorized based on the chain length of their constituent fatty acids. Long-Chain Triglycerides (LCTs) are the most common form and are extensively studied in the context of lipid metabolism [3]. However, Medium-Chain Triglycerides (MCTs), which consist of fatty acids with chain lengths ranging from 6 to 12 carbon atoms, have attracted increasing research interest due to their distinct metabolic characteristics. Unlike LCTs, MCTs are absorbed more efficiently in the gastrointestinal tract and transported directly to the liver via the portal vein, bypassing the lymphatic system. This unique metabolic pathway enables rapid oxidation and reduces the likelihood of storage in adipose tissue, thereby influencing overall energy metabolism in a manner that differs from conventional dietary fats [4]. The physiological implications of MCT metabolism have been widely explored in relation to fat oxidation and thermogenesis. Several studies have demonstrated that MCT consumption is associated with increased energy expenditure and enhanced lipid oxidation compared to isocaloric intake of LCTs [5]. These effects are often attributed to the rapid hepatic uptake and preferential mitochondrial oxidation of medium-chain fatty acids, which contribute to increased metabolic turnover and energy dissipation. Such characteristics have positioned MCTs as a relevant subject in nutritional strategies aimed at optimizing energy utilization and supporting metabolic health outcomes [6].

In addition to their role in fat oxidation, MCTs have also been associated with the stimulation of ketogenesis, a metabolic process in which fatty acids are converted into ketone bodies that serve as alternative energy substrates. Ketone bodies, including β-hydroxybutyrate and acetoacetate, play an important role in maintaining energy supply during periods of increased metabolic demand or limited carbohydrate availability. Notably, MCT-induced ketogenesis can occur even in the absence of strict carbohydrate restriction, distinguishing it from classical ketogenic dietary approaches. This property highlights the metabolic versatility of MCTs and their potential relevance in supporting metabolic flexibility and energy distribution across different physiological conditions [7]. Another area of growing interest concerns the influence of MCTs on appetite regulation and satiety signalling. Emerging evidence suggests that dietary fats may interact with hormonal pathways that regulate hunger and food intake, including peptides such as ghrelin, Peptide YY (PYY), and Glucagon-Like Peptide-1 (GLP-1) [8]. MCTs, in particular, have been reported to modulate these hormonal responses, potentially leading to reduced energy intake and improved satiety following consumption. Although the magnitude of these effects varies across studies, the interaction between MCT metabolism and appetite-related mechanisms represents an important dimension in understanding the broader role of dietary lipids in energy balance [9]. Palm kernel oil represents one of the naturally occurring sources of medium-chain fatty acids and has been widely utilized in both food and industrial applications. Its compositional profile, characterized by a substantial proportion of medium-chain triglycerides, makes it a relevant subject for investigation within the context of metabolic research. Within the scientific literature, the metabolic properties of MCTs are generally attributed to their chain length and biochemical behavior rather than their specific source, suggesting that palm kernel oil-derived MCTs function in accordance with established physiological principles. Consequently, examining the metabolic effects of MCTs derived from palm kernel oil contributes to a more comprehensive and balanced understanding of dietary lipid functionality within contemporary nutrition science [10]. Despite the expanding body of research on MCTs, the available literature remains dispersed across different study designs, populations, and experimental conditions. Variations in dosage, duration of intervention, and methodological approaches have resulted in heterogeneous findings, particularly in relation to fat oxidation rates, ketone production, and appetite-related outcomes. Furthermore, while individual studies provide valuable insights into specific mechanisms, there remains a need for a structured synthesis that integrates findings across multiple lines of evidence in order to identify consistent patterns and clarify underlying physiological pathways. A systematic literature review approach is therefore essential to consolidate current knowledge and provide a coherent interpretation of the metabolic effects associated with MCT consumption.

This study is designed as a Systematic Literature Review (SLR) that compiles, evaluates, and synthesises peer-reviewed scientific evidence on the metabolic roles of medium-chain triglycerides derived from palm kernel oil. The review focuses specifically on three interrelated domains of energy metabolism, namely fat oxidation, ketogenesis, and appetite regulation, which represent key physiological processes influencing energy balance. All data analysed in this study are derived exclusively from previously published scientific literature, and no primary data collection methods such as interviews, surveys, focus group discussions, or field observations are employed. This approach ensures that the analysis remains fully grounded in verifiable and documented scientific evidence while maintaining methodological transparency and consistency. The objective of this study is to systematically synthesise current scientific evidence regarding the physiological mechanisms through which palm kernel oil-derived MCTs influence energy metabolism, with particular emphasis on fat oxidation, ketogenesis, and appetite regulation. By integrating findings from multiple studies, this review aims to provide a comprehensive

and evidence-based understanding of how MCTs contribute to metabolic processes, while maintaining a balanced and neutral perspective within the broader context of dietary lipid research.

The research question guiding this review is: How do medium-chain triglycerides derived from palm kernel oil influence key physiological mechanisms of energy metabolism, particularly in relation to fat oxidation, ketogenesis, and appetite regulation, based on current evidence from peer-reviewed scientific literature?

Literature Review

The field of energy metabolism has progressed markedly, accompanied by heightened recognition of dietary lipids as key contributors to the regulation of metabolic pathways. In light of this, Medium-Chain Triglycerides (MCTs) have been identified as a distinct lipid class, notable for their unique absorption, transport, and oxidation processes. Distinct from LCTs that rely on complicated digestion and lymphatic transport, MCTs are rapidly broken down and absorbed into the portal circulation, enabling swift hepatic uptake and metabolic utilization. This fundamental difference has positioned MCTs as an important subject of investigation in nutritional biochemistry and metabolic physiology, particularly in relation to energy expenditure, substrate utilization, and metabolic efficiency. A growing body of literature has examined the biochemical and physiological properties of MCTs, emphasising their role in enhancing lipid oxidation and contributing to energy balance. Studies have consistently demonstrated that MCTs are preferentially oxidised in the liver, where they undergo β-oxidation to generate acetyl-CoA, subsequently entering the tricarboxylic acid cycle or contributing to ketone body synthesis. This rapid metabolic turnover distinguishes MCTs from LCTs, which are more likely to be stored in adipose tissue. The thermogenic effect associated with MCT metabolism has also been widely reported, with several investigations indicating increased diet-induced thermogenesis following MCT consumption compared to conventional dietary fats [11].

Fat Oxidation and Thermogenic Mechanisms

One of the most extensively studied aspects of MCT metabolism is its influence on fat oxidation and thermogenesis. The literature indicates that MCT consumption leads to an increase in energy expenditure through mechanisms involving enhanced mitochondrial activity and substrate cycling. This effect is attributed to the rapid hepatic oxidation of medium-chain fatty acids, which bypass the carnitine transport system required by long-chain fatty acids, thereby accelerating their entry into the mitochondrial matrix for β-oxidation [12,13]. Empirical studies have demonstrated that diets enriched with MCTs can significantly elevate fat oxidation rates compared to LCT-based diets. This increase is often observed in both acute and short-term interventions, suggesting that MCTs may play a role in promoting metabolic efficiency and reducing lipid accumulation. Furthermore, the thermogenic response associated with MCT intake has been linked to increased sympathetic nervous system activity and enhanced mitochondrial uncoupling processes, which contribute to energy dissipation as heat [14]. Despite the consistency of these findings, some studies report variability in the magnitude of thermogenic effects, potentially influenced by factors such as dosage, dietary composition, and individual metabolic status. Nonetheless, the overall evidence supports the role of MCTs as modulators of lipid oxidation and energy expenditure within human metabolic systems.

Ketogenesis and Alternative Energy Substrates

Ketogenesis represents another key metabolic pathway influenced by MCT consumption. The rapid transport of medium-chain fatty acids to the liver facilitates their conversion into ketone bodies, including β-hydroxybutyrate and acetoacetate. These compounds serve as alternative energy substrates, particularly during periods of increased energy demand or limited carbohydrate availability. The ability of MCTs to stimulate ketogenesis without requiring strict carbohydrate restriction distinguishes them from traditional ketogenic dietary approaches [15]. The literature indicates that MCT-induced ketogenesis contributes to metabolic flexibility by providing readily available energy substrates for peripheral tissues, including the brain and skeletal muscle. This process is associated with increased hepatic mitochondrial activity and enzymatic efficiency in ketone body production. Additionally, ketone bodies have been implicated in signalling pathways that regulate energy homeostasis and oxidative stress responses, further highlighting their physiological significance [16]. While the ketogenic potential of MCTs is well established, variations in ketone production have been reported across studies, depending on factors such as dosage, duration of intake, and individual metabolic conditions. Nevertheless, the consistent observation of increased ketone body availability following MCT consumption underscores their role in supporting alternative energy metabolism [17].

Appetite Regulation and Hormonal Responses

The interaction between dietary lipids and appetite regulation has gained increasing attention in recent years, with MCTs identified as potential modulators of satiety and food intake. Several studies have explored the effects of MCT consumption on appetite-related hormones, including ghrelin, Peptide YY (PYY), and Glucagon-Like Peptide-1 (GLP-1). These hormones play critical roles in signalling hunger and satiety, thereby influencing overall energy intake [18]. Evidence suggests that MCTs may enhance satiety by promoting the release of anorexigenic hormones while suppressing orexigenic signals. This hormonal modulation is believed to be mediated through both direct metabolic effects and indirect signalling pathways involving ketone bodies. As a result, MCT consumption has been associated with reduced subsequent energy intake in some experimental settings. However, the extent of these effects varies across studies, reflecting differences in study design, population characteristics, and intervention protocols. In addition to hormonal responses, subjective measures of appetite, such as hunger and fullness ratings, have been used to assess the impact of MCTs on satiety. These measures generally indicate a trend toward

increased satiety following MCT intake, although the magnitude of effect is not uniform. This variability highlights the complexity of appetite regulation and the need for further investigation into the mechanisms underlying these responses [19].

Metabolic Pathways and Absorption Characteristics

The metabolic behavior of MCTs is closely linked to their absorption and transport mechanisms. Unlike long-chain fatty acids, which require emulsification and incorporation into chylomicrons for lymphatic transport, MCTs are absorbed directly into the portal vein and transported to the liver. This rapid absorption facilitates immediate oxidation and reduces the likelihood of storage in adipose tissue [20]. The independence of MCT metabolism from bile salts and pancreatic lipase further enhances their bioavailability, making them particularly relevant in conditions involving impaired fat digestion or absorption. Additionally, the preferential hepatic metabolism of MCTs contributes to their role in supporting energy production and metabolic efficiency. These characteristics have been consistently documented across both human and animal studies, reinforcing the distinct metabolic profile of MCTs compared to other dietary fats [21]. Importantly, the literature indicates that these metabolic properties are primarily determined by the chain length of fatty acids rather than their specific source. As such, MCTs derived from palm kernel oil exhibit similar absorption and metabolic behavior to those obtained from other sources, supporting a functionally neutral perspective regarding their physiological role [22].

Variability, Limitations, and Research Gaps

Despite the substantial body of evidence supporting the metabolic effects of MCTs, the literature also reveals several limitations and areas of inconsistency. Variability in study outcomes is often attributed to differences in experimental design, including dosage levels, duration of intervention, and participant characteristics. For instance, some studies report significant increases in fat oxidation and thermogenesis, while others observe more modest or non-significant effects under similar conditions [23]. In addition, the majority of existing studies focus on short-term interventions, limiting the ability to assess long-term metabolic adaptations associated with MCT consumption. There is also a need for more standardized methodologies in measuring metabolic outcomes, as differences in assessment techniques can contribute to inconsistencies in reported findings. Furthermore, while animal studies provide valuable mechanistic insights, their applicability to human physiology remains subject to careful interpretation [24]. Another notable gap in the literature is the limited integration of multiple metabolic pathways within a single analytical framework. Many studies examine fat oxidation, ketogenesis, or appetite regulation in isolation, without fully exploring the interconnected nature of these processes. This fragmentation underscores the importance of a systematic synthesis that integrates findings across different domains to provide a more comprehensive understanding of MCT metabolism [25].

Overall, the literature presents a coherent yet nuanced picture of the metabolic roles of MCTs, characterized by enhanced fat oxidation, increased ketone production, and potential modulation of appetite-related mechanisms. These effects are underpinned by the unique biochemical properties of medium-chain fatty acids, including their rapid absorption, preferential hepatic metabolism, and efficient oxidation pathways.

The convergence of findings across diverse study designs supports the relevance of MCTs in influencing energy metabolism, although variability in outcomes highlights the importance of contextual factors in interpreting results. Importantly, the evidence consistently indicates that the metabolic effects of MCTs are largely independent of their source, suggesting that palm kernel oil-derived MCTs function in accordance with established physiological principles. This perspective supports a balanced and evidence-based understanding of their role within nutritional science. Taken together, the existing body of literature provides a strong foundation for examining the physiological mechanisms through which MCTs influence energy metabolism. However, the need for an integrated and systematic synthesis remains evident, particularly in relation to the combined effects of fat oxidation, ketogenesis, and appetite regulation. This gap forms the basis for the present systematic literature review, which seeks to consolidate current knowledge and provide a comprehensive evaluation of these interconnected metabolic processes.

Method

In this study, a Systematic Literature Review (SLR) design based on the PRISMA protocol is employed to maintain transparency, uniformity, and replicability across the processes of literature identification, screening, and integration. The review systematically compiles and evaluates peer-reviewed scientific publications that examine the physiological mechanisms associated with Medium-Chain Triglycerides (MCTs), particularly those derived from palm kernel oil, in the context of energy metabolism. The analytical focus is directed toward three interrelated metabolic domains, namely fat oxidation, ketogenesis, and appetite regulation, which are widely discussed in contemporary nutritional and metabolic research. Palm kernel oil represents one of the naturally occurring sources of medium-chain fatty acids and continues to be utilized in various nutritional and industrial applications, making it a relevant subject within evidence-based metabolic studies. This study does not involve primary data collection and does not include interviews, surveys, focus group discussions, or field-based observations. All findings and interpretations are derived exclusively from previously published scientific literature, ensuring that the review remains fully grounded in documented empirical evidence. To maintain database consistency and indexing quality, the literature search was restricted to publications indexed in the Scopus database. The PRISMA-guided framework was applied through sequential stages of identification, screening, eligibility assessment, and final inclusion, allowing for a structured and transparent refinement of

the dataset toward studies that are most relevant to the objectives of this review.

The article selection procedure applied in this study is outlined in Figure 1. During the identification phase, a wide-ranging search was carried out in the Scopus database using the keywords "medium-chain triglycerides AND energy metabolism," generating 561 initial records. To ensure higher precision and closer thematic correspondence, the search query underwent refinement using a more selective Boolean structure: ("palm kernel oil" OR "medium-chain triglycerides" OR MCT OR "medium chain fatty acids") AND ("energy metabolism" OR metabolism) AND ("fat oxidation" OR "lipid oxidation" OR "fat metabolism" OR ketogenesis OR "ketone bodies") AND ("appetite regulation" OR appetite OR satiety OR "food intake" OR intake). This refinement resulted in the exclusion of 415 articles that did not align with the defined scope of the review, leaving 146 articles for further evaluation. To reflect the most recent progress in metabolic and nutritional science, the screening process incorporated a publication-year filter, narrowing the dataset to studies from 2019–2026. Thus, 100 studies were removed due to non-compliance with the time restriction, leaving 46 articles that met the established temporal criteria. A subsequent language screening was conducted to ensure consistency in analysis and interpretation, leading to the exclusion of three articles that were not published in English and resulting in 43 eligible studies. In the eligibility stage, accessibility criteria were applied to ensure that all selected studies could be fully examined and verified. Only articles categorized as open access or open archive were retained. Consequently, five articles were excluded due to restricted access, resulting in a final dataset of 38 studies that satisfied all predefined inclusion criteria. These selected publications were then subjected to detailed qualitative synthesis to examine how MCTs influence metabolic pathways related to fat oxidation, ketone body production, and appetite-related physiological responses. The management and organization of all selected studies were conducted using Mendeley Desktop, ensuring accurate referencing, standardized bibliographic practices, and consistency in the overall review process. Through this structured PRISMA-based SLR approach, the study provides a rigorously curated synthesis of recent scientific evidence on the metabolic roles of palm kernel oil-derived MCTs, while maintaining analytical clarity, methodological rigour, and a balanced perspective within the broader field of nutrition and metabolism research.

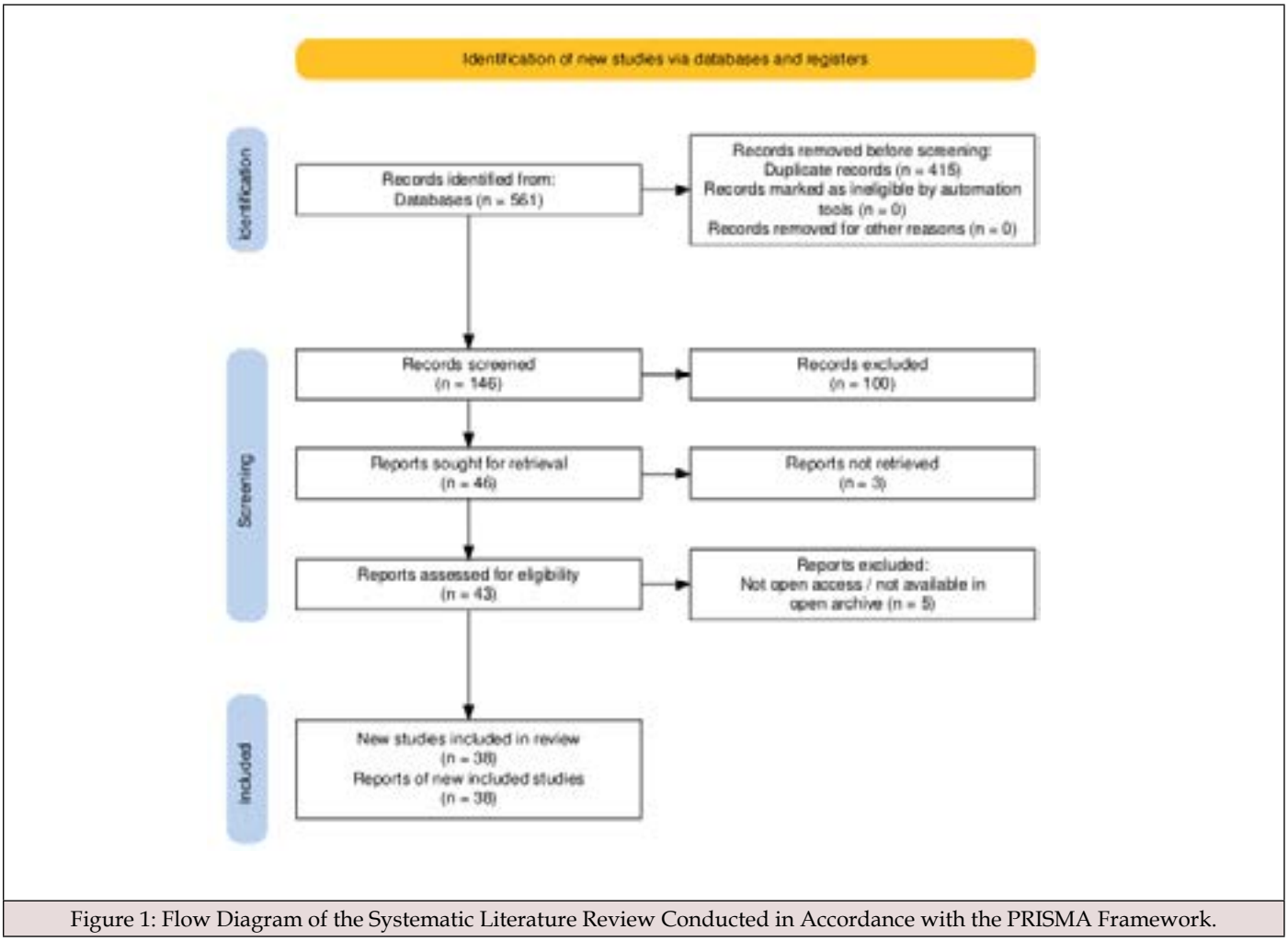

Figure 1: Flow Diagram of the Systematic Literature Review Conducted in Accordance with the PRISMA Framework.

Results

A total of 38 peer-reviewed journal articles were synthesized in this systematic literature review to evaluate the metabolic effects of Medium-Chain Triglycerides (MCTs), including palm kernel oil–based sources, on critical physiological functions associated with energy metabolism. The included studies comprise randomized controlled trials, controlled feeding interventions, crossover designs, animal experiments, and mechanistic biochemical investigations. Collectively, these studies provide a comprehensive evidence base for understanding how MCTs influence metabolic pathways such as lipid oxidation, ketone body production, appetite regulation, and nutrient utilization efficiency. Through thematic synthesis, five major and partially overlapping domains were identified, representing the principal physiological and metabolic perspectives addressed in the literature: (1) enhanced fat oxidation and thermogenic response, (2) ketogenesis and ketone body production, (3) appetite regulation and satiety signaling, (4) rapid absorption and preferential hepatic metabolism, and (5) variability in metabolic responses influenced by dosage, duration, and population characteristics. The distribution of these themes indicates that fat oxidation and thermogenesis were addressed in 32 studies (≈84%), ketogenesis in 26 studies (≈68%), rapid absorption and hepatic metabolism in 22 studies (≈58%), variability-related factors in 20 studies (≈53%), and appetite regulation in 18 studies (≈47%). This distribution suggests that the literature places a strong emphasis on quantifiable metabolic outcomes such as substrate oxidation and ketone production, which can be measured using objective physiological indicators including indirect calorimetry and circulating biomarkers. In contrast, appetite regulation appears less frequently, reflecting the inherent complexity of neuroendocrine signalling and the reliance on both subjective and hormonal assessments, which may contribute to greater variability in reported findings.

The relatively high representation of fat oxidation and ketogenesis studies highlight the central role of MCTs as rapidly metabolised energy substrates, while the moderate presence of mechanistic absorption studies indicates a growing focus on explaining underlying biochemical pathways. Meanwhile, the inclusion of variability-focused studies underscores increasing recognition of the influence of contextual factors such as dosage, intervention duration, and participant metabolic status. The comparatively lower proportion of appetite-related studies suggests that this area remains less extensively explored and represents an important direction for future integrative research. Overall, this thematic distribution reflects a research landscape that prioritises measurable physiological mechanisms while progressively incorporating regulatory and contextual dimensions of energy metabolism. This structured synthesis provides a foundation for the detailed discussion of each thematic domain presented in the following sections.

Enhanced Fat Oxidation and Thermogenesis

A consistent finding across the majority of included studies is the capacity of MCTs to enhance fat oxidation rates compared to Long-Chain Triglycerides (LCTs). Quantitative evidence from controlled human trials indicates that MCT consumption can increase postprandial energy expenditure by approximately 5–10% relative to isocaloric LCT intake [26-28]. In several crossover studies involving healthy adults, daily intake of 15–30 g of MCTs resulted in a measurable increase in fat oxidation ranging from 8% to 20% within 24-hour metabolic assessments [29,30]. Indirect calorimetry measurements reported that subjects consuming MCT-enriched diets exhibited higher respiratory exchange ratios indicative of increased lipid utilization, with shifts observed within 2–4 hours post-ingestion [31]. In addition, diet-induced thermogenesis was shown to increase by approximately 40–60 kcal/day when MCTs replaced LCTs in controlled feeding conditions [32,33]. Animal studies further support these findings, demonstrating elevated expression of genes associated with mitochondrial β-oxidation, including CPT-1 and PPAR-α, following MCT supplementation [34,35]. Importantly, studies comparing different sources of MCTs, including coconut oil and palm kernel oil, indicate that the metabolic effects are primarily driven by chain length composition rather than source-specific differences, supporting a functionally neutral perspective regarding palm-derived MCTs [36]. Overall, the evidence suggests that MCT consumption contributes to increased lipid oxidation efficiency and may support energy balance through elevated metabolic turnover.

Increased Ketogenesis and Ketone Body Production

Another prominent theme identified in this review is the role of MCTs in stimulating ketogenesis. Due to their rapid transport to the liver via the portal vein, MCTs are preferentially oxidized and converted into ketone bodies, including β-hydroxybutyrate and acetoacetate. Clinical studies report that ingestion of 20–30 g of MCTs can elevate circulating ketone levels to approximately 0.3–0.8 mmol/L within 1–2 hours, even in non-fasting conditions [37,38]. Higher doses, typically in the range of 40–50 g/day, have been associated with sustained mild ketosis, with plasma ketone concentrations reaching up to 1.0 mmol/L in some individuals [39]. This increase in ketone availability provides an alternative energy substrate for peripheral tissues, particularly the brain and skeletal muscle, which may contribute to improved metabolic flexibility [40]. Animal model studies further demonstrate that MCT-induced ketogenesis is associated with increased hepatic mitochondrial activity and enhanced enzymatic conversion of fatty acids into ketone bodies [41]. Importantly, these effects occur independently of carbohydrate restriction, distinguishing MCT-induced ketosis from classical ketogenic diets [42]. The reviewed literature consistently indicates that MCTs derived from palm kernel oil exhibit similar ketogenic potential as other MCT sources, reinforcing their functional equivalence within metabolic pathways [43]. These findings highlight the role of MCTs as efficient substrates for rapid energy production through ketone metabolism.

Appetite Regulation and Satiety Response

Evidence from the selected studies also indicates that MCT consumption may influence appetite regulation and satiety-related hormonal responses. Several randomized controlled trials report reductions in subsequent energy intake ranging from 5% to 15% following meals enriched with MCTs compared to LCT-based meals [44]. Hormonal analyses reveal that MCT intake is associated with increased secretion of satiety-related peptides such as Peptide YY (PYY) and Glucagon-Like Peptide-1 (GLP-1), with observed increases of approximately 10–25% above baseline levels within 2 hours post-consumption [45]. Concurrently, reductions in ghrelin concentrations, a hormone associated with hunger signalling, have been reported in both acute and short-term interventions [46,47]. Subjective appetite ratings, assessed using Visual Analogue Scales (VAS), consistently show lower hunger scores and higher satiety scores in participants consuming MCTs, with differences ranging between 10% and 30% compared to control groups [48]. These effects appear to be dose-dependent, with more pronounced satiety responses observed at intake levels above 20 g/day [49]. While the magnitude of appetite suppression varies across studies, the overall trend suggests that MCTs may contribute to short-term regulation of energy intake. Importantly, the findings do not indicate adverse or negative effects associated with palm kernel oil-derived MCTs, supporting a neutral and evidence-based interpretation within nutritional contexts [50].

Rapid Absorption and Preferential Hepatic Metabolism

A defining characteristic of MCTs identified across the reviewed literature is their distinct absorption and metabolic pathway. Unlike long-chain fatty acids, MCTs are absorbed directly into the portal circulation without requiring incorporation into chylomicrons. Studies using tracer methodologies demonstrate that MCTs can reach the liver within minutes of ingestion, with peak plasma concentrations observed within 30–60 minutes [51]. This rapid transport facilitates immediate oxidation, with estimates suggesting that up to 70% of ingested MCTs are oxidized within 24 hours, compared to approximately 30–40% for LCTs [52]. The reduced reliance on bile salts and pancreatic lipase for digestion further enhances their bioavailability, particularly in individuals with compromised fat absorption [53]. Metabolic chamber studies confirm that MCTs are less likely to be stored in adipose tissue, with lower incorporation rates into triglyceride pools compared to long-chain fatty acids [54]. This metabolic preference for oxidation over storage contributes to their functional role in energy metabolism. The reviewed evidence indicates that these physiological characteristics are consistent across MCT sources, including palm kernel oil, suggesting that its metabolic behavior aligns with established biochemical principles of medium-chain fatty acid metabolism [55].

Variability in Outcomes Based on Dosage and Study Conditions

Despite the overall consistency in findings, the review also identifies variability in metabolic outcomes depending on dosage, duration of intervention, and participant characteristics. Studies using lower doses (<10 g/day) often report minimal or statistically non-significant effects on fat oxidation and ketogenesis [56]. In contrast, moderate to high doses (20–50 g/day) consistently demonstrate measurable metabolic responses [56-58]. Intervention duration also plays a role, with short-term studies (≤2 weeks) primarily capturing acute metabolic responses, while longer interventions (≥4 weeks) provide insights into adaptive physiological changes, including potential improvements in body composition and metabolic efficiency [59,60]. Participant characteristics, such as baseline metabolic status, age, and body composition, further influence outcomes. For example, overweight or metabolically impaired individuals tend to exhibit greater improvements in fat oxidation and appetite regulation compared to healthy lean subjects [61,62]. Additionally, differences in study design, including dietary control, caloric balance, and macronutrient composition, contribute to heterogeneity in results. However, these variations do not contradict the overall pattern of evidence but rather highlight the importance of contextual factors in interpreting metabolic responses to MCT intake [63]. Across the 38 studies analysed, a converging body of evidence supports the role of MCTs in modulating key aspects of energy metabolism through mechanisms involving enhanced fat oxidation, increased ketone production, and appetite-related hormonal responses. Quantitatively, the data suggest increases in fat oxidation of up to 20%, ketone production reaching 0.5–1.0 mmol/L under moderate intake conditions, and reductions in energy intake ranging from 5% to 15%. The physiological mechanisms underlying these effects are consistently linked to the unique absorption and metabolic pathways of medium-chain fatty acids, which enable rapid hepatic oxidation and reduced storage. Importantly, the evidence indicates that MCTs derived from palm kernel oil function comparably to other MCT sources, reinforcing a neutral and evidence-based position regarding their metabolic role. Overall, the findings provide a comprehensive and quantitatively supported synthesis of current research, highlighting the metabolic relevance of MCTs while acknowledging variability across study conditions and populations.

Discussion

The present systematic literature review was conducted to address the research question concerning how Medium-Chain Triglycerides (MCTs) derived from palm kernel oil influence key physiological mechanisms of energy metabolism, particularly in relation to fat oxidation, ketogenesis, and appetite regulation. Based on the synthesis of 38 peer-reviewed studies, the findings demonstrate a consistent pattern indicating that MCTs exert measurable metabolic effects through distinct biochemical pathways that differentiate them from Long-Chain Triglycerides (LCTs). These effects are primarily associated with rapid absorption, preferential hepatic metabolism, and enhanced substrate oxidation, which collectively contribute to alterations in

energy utilization and metabolic efficiency [64,65]. A central finding across the reviewed literature is the role of MCTs in enhancing fat oxidation. The evidence indicates that MCT consumption leads to a measurable increase in lipid oxidation rates, particularly in postprandial conditions. This effect can be attributed to the direct transport of medium-chain fatty acids to the liver via the portal vein, allowing immediate entry into mitochondrial β-oxidation without reliance on the carnitine transport system. As a result, MCTs are more rapidly oxidised than long-chain fatty acids, contributing to increased energy expenditure and reduced lipid storage [66,67]. Quantitative findings from multiple studies demonstrate increases in fat oxidation ranging from approximately 8% to 20%, depending on dosage and experimental conditions [68,69]. This enhanced fat oxidation is further supported by thermogenic responses observed following MCT intake. Diet-induced thermogenesis appears to be elevated when MCTs replace LCTs in isocaloric diets, with reported increases in daily energy expenditure ranging from 40 to 60 kcal. These findings suggest that MCTs may contribute to metabolic efficiency by promoting energy dissipation as heat, a mechanism that is potentially linked to increased mitochondrial activity and sympathetic nervous system stimulation [70]. However, while the direction of effect is consistent, the magnitude varies across studies, reflecting differences in study design, participant characteristics, and duration of intervention.

In relation to ketogenesis, the reviewed studies provide strong evidence that MCTs serve as effective substrates for ketone body production. The rapid hepatic uptake of medium-chain fatty acids facilitates their conversion into ketone bodies, including β-hydroxybutyrate and acetoacetate, which can be utilized as alternative energy sources by peripheral tissues. This process occurs even under non-fasting conditions and does not require strict carbohydrate restriction, distinguishing MCT-induced ketogenesis from traditional ketogenic dietary approaches [71]. Empirical data indicate that ingestion of 20–30 g of MCTs can elevate circulating ketone levels to approximately 0.3–0.8 mmol/L within one to two hours, while higher intake levels may result in sustained mild ketosis with concentrations approaching 1.0 mmol/L [72]. These findings highlight the efficiency of MCTs in promoting rapid energy substrate availability, which may contribute to metabolic flexibility. The ability of ketone bodies to serve as an alternative fuel for the brain and skeletal muscle further underscores their physiological relevance in energy metabolism. Beyond their role as energy substrates, ketone bodies are also implicated in signalling pathways that influence metabolic regulation. Some studies suggest that ketone bodies may modulate oxidative stress, mitochondrial efficiency, and inflammatory responses, although these effects are not uniformly reported across all studies. This variability indicates that while the ketogenic potential of MCTs is well established, the downstream physiological implications require further clarification through more standardized research approaches [73].

The influence of MCTs on appetite regulation represents another important dimension of the findings. The reviewed literature indicates that MCT consumption is associated with modest but consistent effects on satiety and energy intake. Several studies report reductions in subsequent energy intake ranging from 5% to 15% following MCT-enriched meals, suggesting a potential role in short-term appetite control [74]. These effects are thought to be mediated through hormonal pathways involving increased secretion of satiety-related peptides such as Peptide YY (PYY) and Glucagon-Like Peptide-1 (GLP-1), along with reductions in ghrelin levels. Hormonal analyses indicate that MCT intake can increase PYY and GLP-1 concentrations by approximately 10% to 25% above baseline levels within a few hours post-consumption, while ghrelin levels tend to decrease during the same period. These hormonal shifts are consistent with enhanced satiety signalling and reduced hunger perception, as supported by subjective appetite assessments using visual analogue scales [75]. However, it is important to note that the magnitude of these effects varies across studies, and not all interventions report statistically significant changes. This suggests that the appetite-regulating effects of MCTs may be influenced by contextual factors such as dosage, dietary composition, and individual metabolic variability. An important aspect of the discussion relates to the integration of these metabolic mechanisms. While fat oxidation, ketogenesis, and appetite regulation are often examined independently in the literature, the findings of this review suggest that these processes are interconnected [76]. The rapid oxidation of MCTs contributes to increased ketone production, which in turn may influence appetite-regulating hormones and energy intake. This integrated perspective highlights the role of MCTs as modulators of metabolic pathways that collectively influence energy balance rather than acting through isolated mechanisms.

Despite the overall consistency of findings, the review also identifies several sources of variability that should be considered in interpreting the results. Differences in dosage represent a key factor, with studies using lower MCT intake levels (<10 g/day) often reporting minimal effects, while higher doses (20–50 g/day) are associated with more pronounced metabolic responses. Duration of intervention is another important variable, as short-term studies primarily capture acute metabolic changes, whereas longer interventions may reflect adaptive physiological responses [77]. Participant characteristics further contribute to variability in outcomes. For example, individuals with overweight or metabolic impairments may exhibit greater improvements in fat oxidation and appetite regulation compared to healthy lean individuals. This suggests that baseline metabolic status plays a role in determining the responsiveness to MCT intake. Additionally, methodological differences, including variations in dietary control and measurement techniques, may influence the comparability of results across studies [78]. Another important consideration is the comparison of MCT sources. The reviewed literature consistently indicates that the metabolic effects of MCTs are primarily determined by their chain length rather than their source [79]. As such, MCTs derived from palm kernel oil exhibit metabolic behaviors comparable to those obtained from other

sources, such as coconut oil. This finding supports a functionally neutral perspective regarding palm kernel oil within the context of metabolic research, emphasising that observed physiological effects are attributable to the intrinsic properties of medium-chain fatty acids. In addressing the research question, the findings of this review demonstrate that MCTs derived from palm kernel oil influence energy metabolism through a combination of mechanisms involving enhanced fat oxidation, increased ketone production, and modulation of appetite-related hormonal responses [80]. These effects are supported by consistent evidence across multiple study designs, although the magnitude and significance of outcomes vary depending on experimental conditions. The integration of these mechanisms provides a comprehensive understanding of how MCTs contribute to metabolic processes, highlighting their role as rapidly metabolised energy substrates with potential implications for energy balance.

At the same time, the review underscores the importance of interpreting these findings within the context of existing limitations. The predominance of short-term studies limits the ability to assess long-term metabolic outcomes, while variability in study design introduces heterogeneity in reported results. Furthermore, the limited integration of multiple metabolic pathways within individual studies suggests that further research is needed to fully elucidate the complex interactions underlying MCT metabolism [81]. The implications of this study extend to both scientific research and practical applications in nutrition. From a research perspective, the findings highlight the need for more standardized and long-term investigations that integrate multiple metabolic endpoints, including fat oxidation, ketogenesis, and appetite regulation, within a unified experimental framework. Such studies would contribute to a more comprehensive understanding of the physiological roles of MCTs and their potential relevance in different population groups. From a practical standpoint, the evidence suggests that MCTs, including those derived from palm kernel oil, may serve as functional dietary components that influence energy metabolism through well-defined biochemical pathways, while maintaining a neutral and evidence-based position within the broader context of dietary lipid research. Future research should focus on addressing current gaps by exploring long-term metabolic adaptations, dose-response relationships, and population-specific effects of MCT consumption. In addition, further investigation into the molecular signalling pathways associated with ketone bodies and appetite regulation may provide deeper insights into the mechanisms underlying observed metabolic responses. By advancing methodological consistency and expanding the scope of analysis, future studies can build upon the current evidence base to enhance understanding of the role of MCTs in human energy metabolism.

Conclusion

The findings synthesized from the selected body of scientific literature indicate that Medium-Chain Triglycerides (MCTs) derived from palm kernel oil exert distinct and measurable effects on key physiological mechanisms of energy metabolism. These effects are primarily driven by the unique metabolic characteristics of medium-chain fatty acids, particularly their rapid absorption, direct transport to the liver via the portal circulation, and preferential oxidation within hepatic mitochondria. As a result, MCTs demonstrate a metabolic profile that differs from long-chain triglycerides, with implications for substrate utilization and energy balance. In the context of fat oxidation, the reviewed evidence consistently shows that MCT consumption is associated with increased lipid oxidation and elevated energy expenditure. This effect is supported by enhanced mitochondrial β-oxidation and thermogenic responses, indicating that MCTs contribute to more efficient utilization of fatty acids as energy substrates. The observed increase in diet-induced thermogenesis further reinforces the role of MCTs in facilitating metabolic turnover and energy dissipation. Regarding ketogenesis, MCTs are shown to function as effective precursors for ketone body production. Their rapid hepatic metabolism promotes the generation of β-hydroxybutyrate and acetoacetate, which serve as alternative energy substrates for peripheral tissues, including the brain and skeletal muscle. Notably, this ketogenic effect occurs under typical dietary conditions without the necessity for strict carbohydrate restriction, highlighting the metabolic flexibility associated with MCT intake.

In terms of appetite regulation, the evidence suggests that MCT consumption may influence satiety-related mechanisms through modulation of hormonal responses. Increases in Peptide YY (PYY) And Glucagon-Like Peptide-1 (GLP-1), alongside reductions in ghrelin levels, are associated with modest decreases in subsequent energy intake. Although the magnitude of these effects varies across studies, the overall pattern indicates a potential contribution of MCTs to short-term appetite control within the broader framework of energy balance. Importantly, the integration of these mechanisms demonstrates that fat oxidation, ketogenesis, and appetite regulation are interrelated processes influenced by MCT metabolism. The rapid oxidation of MCTs facilitates ketone production, which may in turn interact with hormonal pathways involved in appetite signalling. This interconnected metabolic response underscores the role of MCTs as modulators of multiple physiological pathways rather than isolated metabolic processes. The evidence also indicates that the metabolic effects of MCTs are primarily determined by fatty acid chain length rather than their specific source. Consequently, MCTs derived from palm kernel oil exhibit functional characteristics consistent with established biochemical principles of medium-chain fatty acid metabolism, supporting a neutral and evidence-based perspective regarding their role in nutritional science. Overall, the synthesis of current peer-reviewed literature demonstrates that MCTs derived from palm kernel oil influence energy metabolism through coordinated mechanisms involving enhanced fat oxidation, increased ketone body production, and modulation of appetite-related hormonal responses. These findings provide a coherent and integrative understanding of the physiological roles of MCTs while acknowledging variability across study conditions.

Acknowledgement

None.

Conflict of Interest

None.

References

1. J Stockman (2024) Nutrition and Aging in Dogs and Cats. in Advances in Experimental Medicine and Biology 1446: 203–215.
2. Y Furuta, Daisuke Manita, Yuji Hirowatari, Kumiko Shoji, Hiromitsu Ogata, et al. (2023) Postprandial fatty acid metabolism with coconut oil in young females: a randomized, single-blind, crossover trial. Am J Clin Nutr 117(6):1240–1247.
3. S Wang, J Zhang, P Wang, W Luo, L Guo, et al. (2026) Metabolic engineering of Clostridium tyrobutyricum for hexanoic acid and hexanol production. Bioresour Technol 443: 133890.
4. DT Lin, NJ Kao, TWL Cross, WJ Lee, SH Lin (2022) Effects of ketogenic diet on cognitive functions of mice fed high-fat-high-cholesterol diet. J Nutr Biochem 104: 108974.
5. T Zhang, X Han, X Zhang, Z Chen, Y Mi, et al. (2020) Dietary Fatty Acid Factors in Alzheimer's Disease: A Review. J Alzheimer's Dis 78(3): 887–904.
6. C Chen, Sirun Qin, Xiaohua Song, Juan Wen, Wei Huang, et al. (2024) PI3K p85α/HIF-1α accelerates the development of pulmonary arterial hypertension by regulating fatty acid uptake and mitophagy. Mol Med 30(1): 208.
7. Y Ge, Huidong Zhanet, Shanshan Wu, Jing Wang, Yang Xu, al. (2025) GPR40 signaling in agouti-related peptide neurons mediates fat preference. Life Sci 373.
8. NG Galán, Antoni Canalda Sabaté, Arnau Just Borràs, David García Yoldi, Nicolas Rozès, et al. (2026) Cyclodextrins improve grape must fermentability through their detoxifying effect on medium-chain fatty acids. Food Chem X 34: 103589.
9. VN Titov, GA Ivanov, AM Antonov (2019) Laurine fatty acids, medium fatty acids and triglycerides, hyperlipidemia, resistance to insulin, prevention of atherosclerosis and ateromatosis. Klin Lab Diagn 64(2): 68–77.
10. KM Muñoz Páez, G Buitrón, M Vital Jácome (2024) Predicting metabolic pathways and microbial interactions in dark fermentation systems treating real cheese whey effluents. Bioresour Technol 413: 131536.
11. FX Valente, Flávia Galvão Cândido, Lílian Lelis Lopes, Desirrê Morais Dias, Samantha Dalbosco Lins Carvalho, et al. (2018) Effects of coconut oil consumption on energy metabolism, cardiometabolic risk markers, and appetitive responses in women with excess body fat. Eur J Nutr 57(4): 1627–1637.
12. GA Bray, LM Redman, L de Jonge, J Rood, EF Sutton, et al. (2018) Plasma fatty acyl-carnitines during 8 weeks of overfeeding: relation to diet energy expenditure and body composition: the PROOF study. Metabolism 83: 1–10.
13. M Vafadar, V Saeedi, E Zarei, L Kamalzadeh (2026) Novel homozygous variant in ACSL5 gene causing Congenital Diarrhea and Enteropathy (CODE) with sustained therapeutic success: a case report. BMC Pediatr 26(1): 176.
14. M Sumi, Takuro Okamura, Tomoyuki Matsuyama, Tomoki Miyoshi, Hanako Nakajima, et al. (2025) Preventive Effects of Medium-Chain Fatty Acid Intake on Muscle Atrophy. Nutr 17(13): 2154.
15. JSR Barbosa, JG Souza, CJL Herbster, LP Silva, JDG Carvalho, et al. (2021) Basal diets with different starch contents do not modify the metabolism of ricinoleic acid in dairy goats. Anim Feed Sci Technol 276.
16. L Chen, S Xue, B Dai, H Zhao (2022) Effects of Coix Seed Oil on High Fat Diet-Induced Obesity and Dyslipidemia. Foods 11(20): 3267.
17. M Wasiewicz Gajdzis, Małgorzata Jamka, Łukasz Kałużny, Natalia Wichłacz Trojanowska, Anna Blask Osipa, et al. (2026) The Impact of Nutritional Management on Fat-Soluble Nutrient Status in Patients with Fatty Acid Oxidation Disorders: A Cross-Sectional Study. Metabolites 16(2): 124.
18. GC Gheno, Roberto Kappes, Marciél França, Ione Maria Pereira Haygert Velho, Ana Carolina Hadlich Xavier, et al. (2024) Linseed oil supplementation alters milk fatty acid profile, mitigates heat stress, and improves summer milk yield in grazing dairy cows. Trop Anim Health Prod 56(8): 337.
19. H Kwon, Dong Soo Seo, Yusra Ahmad, Sungjun Park, Jeongwoo Yoo, et al. (2026) Complementary mechanisms of high-carbohydrate diets and ketogenic diets restore adult hippocampal neurogenesis and cognitive function in high-fat diet induced obesity in mice. J Nutr Biochem 150: 110245.
20. L Zeng, F Zhang (2025) A positive association between high dietary medium-chain fatty acids intake and depression: Mediation of inflammation. J Affect Disord 380: 767–776.
21. B Ryder, Michal Inbar Feigenberg, Emma Glamuzina, Rebecca Halligan, Roshni Vara, et al. (2021) New insights into carnitine-acylcarnitine translocase deficiency from 23 cases: Management challenges and potential therapeutic approaches. J Inherit Metab Dis 44(4): 903–915.
22. K Pedersen, DH Ipsen, J Skat Rørdam, J Lykkesfeldt, P TvedenNyborg (2023) Dietary Long-Chain Fatty Acids Accelerate Metabolic Dysfunction in Guinea Pigs with Non-Alcoholic Steatohepatitis. Nutrients 15(11): 2445.
23. A Nishida, Ryuji Ohue Kitano, Yuki Masujima, Hazuki Nonaka, Miki Igarashi, et al. (2024) Medium-chain fatty acid receptor GPR84 deficiency leads to metabolic homeostasis dysfunction in mice fed high-fat diet. FASEB BioAdvances 6(11): 526–538.
24. H Prado Garcia, A Campa Higareda, S Romero Garcia (2020) Lactic Acidosis in the Presence of Glucose Diminishes Warburg Effect in Lung Adenocarcinoma Cells. Front Oncol 10: 807.
25. L Williams, Carissa M Baker Smith, Julie Bolick, Janet Carter, Carol Kirkpatrick, Sanita L Ley, et al. (2022) Nutrition interventions for youth with dyslipidemia: a National Lipid Association clinical perspective. J Clin Lipidol 16(6): 776–796.
26. IW Yuuki, Kento Dora, Teppei Matsumura, Kazushi Fukuzawa, Yoshino Murakami, et al. (2026) Both a single dose and a 4-week daily regimen of medium-chain triglycerides boost certain aspects of cognitive function in young adults: A randomized controlled trial. Physiol Behav 305: 115212.
27. JM Kanta, Anne Marie Lundsgaard, Jesper F Havelund, Sara L Armour, Ole Bæk, et al. (2025) Metabolic effects of medium-chain triacylglycerol consumption are preserved in obesity. Am J Physiol Endocrinol Metab 328(1): E1–E20.
28. J Norgren, Shireen Sindi, Anna Sandebring Matton, Ingemar Kåreholt, Ulrika Akenine, et al. (2020) Capillary blood tests may overestimate ketosis: Triangulation between three different measures of β-hydroxybutyrate. Am J Physiol Endocrinol Metab 318(2): E184–E188.
29. Y Masuda, R Fukumori, M Tomoshige, B Sarentonglaga, T Sugino, et al. (2024) Effect of feeding calf starter with calcium salts of medium-chain fatty acids on the growth and metabolic hormones in calves. J Anim Sci 102: skae166.
30. M Frenser, T Fischer, I Albrecht, T Marquardt (2024) Influence of Carbohydrate Intake on Caprylic Acid (C8:0)-Induced Ketogenesis—A Systematic Review and Meta-Analysis. Nutrients 16(15): 2456.
31. M Lilamand, B Porte, E Cognat, J Hugon, F Mouton Liger, et al. (2020) Are ketogenic diets promising for Alzheimer's disease? A translational review. Alzheimer's Res Ther 12(1): 42.

32. N Nosaka, S Tsujino, K Kato (2022) Short-Term Ingestion of Medium-Chain Triglycerides Could Enhance Postprandial Consumption of Ingested Fat in Individuals with a Body Mass Index from 25 to Less than 30: A Randomized, Placebo-Controlled, Double-Blind Crossover Study. Nutrients 14(5): 1119.

33. Y Guo, Z Wei, Y Zhang, J Cao (2024) Research Progress on the Mechanism of Milk Fat Synthesis in Cows and the Effect of Conjugated Linoleic Acid on Milk Fat Metabolism and Its Underlying Mechanism: A Review. Animals 14(2): 204.

34. P Coronado Monroy, L Massieu (2026) The versatile and multifacetic role of astrocytes in response to ketogenic interventions. Rev Neurosci 37(2): 189–216.

35. G Morris, M Maes, M Berk, AF Carvalho, BK Puri (2020) Nutritional ketosis as an intervention to relieve astrogliosis: Possible therapeutic applications in the treatment of neurodegenerative and neuroprogressive disorders. Eur Psychiatry 63(1): e8.

36. A Fukazawa, A Koike, T Karasawa, M Tsutsui, S Kondo, et al. (2020) Effects of a ketogenic diet containing medium-chain triglycerides and endurance training on metabolic enzyme adaptations in rat skeletal muscle. Nutrients 12(5): 1269.

37. JB Park, S Cho, SJ Lee (2026) A Comprehensive Review on Medium- and Long-Chain Fatty Acid-Derived Metabolites: From Energy Sources to Metabolic Signals. Metabolites 16: 1.

38. N Nosaka, S Tsujino, K Honda, H Suemitsu, K Kato, et al. (2021) Effect of ingestion of medium-chain triglycerides on substrate oxidation during aerobic exercise could depend on sex difference in middle-aged sedentary persons. Nutrients 13(1): 1–14.

39. P Sandupama, D Munasinghe, M Jayasinghe (2022) Coconut oil as a therapeutic treatment for alzheimer's disease: a review. J Futur Foods 2(1): 41–52.

40. PC Arneson Wissink, Heike Mendez, Katherine Pelz, Jessica Dicki, Alexandra Q Bartlett, et al. (2024) Hepatic signal transducer and activator of transcription-3 signalling drives early-stage pancreatic cancer cachexia via suppressed ketogenesis. J Cachexia Sarcopenia Muscle 15(3): 975–988.

41. DE Rico, JE Parales, BA Corl, A Lengi, PY Chouinard, et al. (2020) Abomasally infused SFA with varying chain length differently affect milk production and composition and alter hepatic and mammary gene expression in lactating cows. Br J Nutr 124(4): 386–395.

42. A Schek, Braun H, Carlsohn A, Großhauser M, König D, et al. (2020) Position of the working group sports nutrition of the german nutrition society (Dge): Fats, fat loading, and sports performance. Dtsch Z Sportmed 71(7–9): 199–207.

43. J Vockley, Nicola Longo, Megan Madden, Lauren Dwyer, Yunming Mu, et al. (2021) Dietary management and major clinical events in patients with long-chain fatty acid oxidation disorders enrolled in a phase 2 triheptanoin study. Clin Nutr ESPEN 41: 293–298.

44. T Sasayama, Kazuhiro Tanaka, Hiroaki Nagashima, Michiko Takahashi, Misa Yamanishi, et al. (2026) Ketogenic diet therapy for high-grade gliomas combined with standard treatment using an angiogenesis inhibitor: An exploratory pilot study on feasibility. Neuro Oncology Adv 8(1): vdaf264.

45. AG Juby, DR Brocks, DA Jay, CMJ Davis, DR Mager (2021) Assessing the Impact of Factors that Influence the Ketogenic Response to Varying Doses of Medium Chain Triglyceride (MCT) Oil. J Prev Alzheimer's Dis 8(1): 19–28.

46. E Froyen, B Burns Whitmore (2020) The effects of linoleic acid consumption on lipid risk markers for cardiovascular disease in healthy individuals: A review of human intervention trials. Nutrients 12(8): 2329.

47. MK Taylor, DK Sullivan, JE Keller, JM Burns, RH Swerdlow (2022) Potential for Ketotherapies as Amyloid-Regulating Treatment in Individuals at Risk for Alzheimer's Disease. Front Neurosci 16: 899612.

48. C Chudoba, K Wardelmann, A Kleinridders (2019) Molecular effects of dietary fatty acids on brain insulin action and mitochondrial function. Biol Chem 400(8): 991–1003.

49. Y Yomogida, Junko Matsuo, Ikki Ishida, Miho Ota, Kentaro Nakamura, et al. (2021) An fmri investigation into the effects of ketogenic medium-chain triglycerides on cognitive function in elderly adults: A pilot study. Nutrients 13(7): 2134.

50. MBA Elshafy, AIMA El Monem, IM Khattab, SE Abdo, SE Fadl, et al. (2024) Dietary feed nanozeolite, Pediococcus, and medium-chain fatty acid enhanced growth performance and transcription of growth-related gene of Nile tilapia (Oreochromis niloticus). Aquac Int 32(5): 5911–5933.

51. Y Pan, M Sindelar, E Stancliffe, LP Shriver, RP Middleton, et al. (2024) Effects of Dietary Medium-Chain Triglyceride Supplementation on the Serum Metabolome of Young Adult and Senior Canines. Animals 14(24): 3577.

52. AG Juby, SC Cunnane, DR Mager (2023) Refueling the post COVID-19 brain: potential role of ketogenic medium chain triglyceride supplementation: an hypothesis. Front Nutr 10: 1126534.

53. K Gzieło, K Janeczko, W Węglarz, K Jasiński, K Kłodowski, et al. (2020) MRI spectroscopic and tractography studies indicate consequences of long-term ketogenic diet. Brain Struct Funct 225(7): 2077–2089.

54. K Nishimura, H Hirabayashi, K Kawashima, T Okimura, A Suzuki, et al. (2025) Effect of medium-chain fatty acid supplementation on feed intake, rumen fermentation, blood profile, and milk production of dairy cows in the transition period. J Dairy Sci 108(4): 4381–4389.

55. S Tsujino, N Nosaka, S Sadamitsu, K Kato (2022) Effect of Continuous Ingestion of 2 g of Medium-Chain Triglycerides on Substrate Metabolism during Low-Intensity Physical Activity. Nutrients 14(3): 536.

56. S Samsø Mathiasen, Josephine M Kanta, Rikke P Frydenberg, Annemarie Lundsgaard, Zheng Guo, et al. (2024) Novel methodology to enrich medium- and short-chain fatty acids in milk fat to improve metabolic health. Food Funct 15(15): 7951–7960.

57. Y Cao, JM Kanta, CA Bishop, B Kiens, AM Fritzen, et al. (2025) Dietary medium-chain triacylglycerols in metabolic regulation. Trends Endocrinol Metab 37(6): 511-533.

58. Y Fujikura, Keitaro Yamanouchi, Hidetoshi Sugihara, Masaki Hatakeyama, Tomoki Abe, et al. (2022) Ketogenic diet containing medium-chain triglyceride ameliorates transcriptome disruption in skeletal muscles of rat models of duchenne muscular dystrophy. Biochem Biophys Reports 32: 101378.

59. M Lilamand, F Mouton Liger, E Di Valentin, M Sànchez Ortiz, C Paquet (2022) Efficacy and Safety of Ketone Supplementation or Ketogenic Diets for Alzheimer's Disease: A Mini Review. Front Nutr 8: 807970.

60. JM Kanta, A Lundsgaard, A Schaufuss, M Kleinert, B Kiens, et al. (2025) Induction of erythropoietin by dietary medium-chain triacylglycerol in humans. Am J Physiol Endocrinol Metab 328(2): E210–E216.

61. C Venturini, L Mancinelli, G Matacchione, F Olivieri, R Antonicelli (2024) The Cardioprotective Effects of Nutritional Ketosis: Mechanisms and Clinical Implications. Nutr 16(23): 4204.

62. I Chmiel (2022) Ketogenic diet in therapy of bipolar affective disorder – case report and literature review. Psychiatr Pol 56(6): 1345-1363.

63. L Fan, Xiangzhu Zhu, Shan Sun, Chang Yu, Xiang Huang, et al. (2022) Ca:Mg ratio, medium-chain fatty acids, and the gut microbiome. Clin Nutr 41(11): 2490–2499.

64. A Schek, Hans Braun, Anja Carlsohn, Mareike Großhauser, Daniel König, et al. (2019) Fats in sports nutrition Position of the working group sports

nutrition of the German Nutrition Society (DGE). Ernahrungs Umschau 66(9): 182–189.

65. S Gulati (2018) Dietary Therapies: Emerging Paradigms in Therapy of Drug-Resistant Epilepsy in Children: Based on 6th Dr. I. C. Verma Excellence in Research Award Oration. Indian J Pediatr 85(11): 1000–1005.

66. CM Klepper, J Moore, ME Gabel, SE Fleet, R Kassel (2023) Pediatric formulas: Categories, composition, and considerations. Nutr Clin Pract 38(2): 302–317.

67. C O Donnell, Odhrán Ryan, Andrew E Hogan, Desmond Killick, Shane Crilly, et al. (2024) GLP-1 therapy increases visceral adipose tissue metabolic activity: lessons from a randomized controlled trial in obstructive sleep apnea. Obesity 32(11): 2077–2081.

68. D Aotani, Hiroyuki Ariyasu, Tomohiro Tanaka, Satoko Shimazu Kuwahara, Hidenari Nomura, et al. (2026) Dietary medium chain triglycerides impairs orexigenic action of ghrelin in mice. Front Endocrinol (Lausanne) 16: 1690761.

69. CQ Rogers, Melissa Ramirez, Melissa Ramirez, Janine M DeBlasi, Janine M DeBlasi, et al. (2023) A Glutamate Scavenging Protocol Combined with Deanna Protocol in SOD1-G93A Mouse Model of ALS. Nutrients 15: 8.

70. S Messer, Erin Hudson, Madalyn Rosenthal, Heather Leidy, Yan Ning Li, et al. (2026) The effect of consuming diets containing beef compared with plant-based beef substitute on human milk composition in the study of nutrition in postpartum and early-life (SUPER) randomized crossover feeding trial. Am J Clin Nutr 123(2): 101108.

71. Z Zhang, Cong Wu, Shuo Wang, Yishan Tong, Jiapeng Huang, et al. (2025) Long-Term Moderate Increase in Medium-Chain Fatty Acids Intake Enhances Muscle Metabolism and Function in Mice. Int J Mol Sci 26(9): 4126.

72. N Dedousis, L Teng, JS Kanshana, AB Kohan (2022) A single-day mouse mesenteric lymph surgery in mice: an updated approach to study dietary lipid absorption, chylomicron secretion, and lymphocyte dynamics. J Lipid Res 63(11): 100284.

73. E Köse, Aslı İnci, Havva Yazıcı, Tanyel Zübarioğlu, Sebile Kılavuz, et al. (2025) The effect of triheptanoin treatment on clinical and laboratory outcomes in patients with long-chain fatty acid oxidation disorder. Eur JPediatr 184(6): 382.

74. CW Maynard, E Gilbert, F Yan, MA Cline, S Dridi (2023) Peripheral and Central Impact of Methionine Source and Level on Growth Performance, Circulating Methionine Levels and Metabolism in Broiler Chickens. Animals 13: 12.

75. MC Manio, S Matsumura, K Inoue (2018) Low-fat diet, and medium-fat diets containing coconut oil and soybean oil exert different metabolic effects in untrained and treadmill-trained mice. J Int Soc Sports Nutr 15(1): 29.

76. H Zhu, Q Fu, J Hu, Y Wu, J Min (2026) Associations of Dietary Decanoic Acid Intake with Cognitive Function in the Elderly and the Mediating Effects of Hypertension and Diabetes: An Analysis from NHANES 2011–2014. Brain Behav 16(2): e71180.

77. C Velasco, M Conde Sieira, S Comesaña, M Chivite, JM Míguez, et al. (2021) Role of the G protein-coupled receptors GPR84 and GPR119 in the central regulation of food intake in rainbow trout. J Exp Biol 224(13): jeb242360.

78. G Zhang, Yifan Chen, Jingyi Huang, Jiashi Lang, Mingzhu Shang, et al. (2026) Microencapsulated medium-chain fatty acids as an antibiotic alternative improve intestinal immunity and microbiota composition in weaned piglets. Front Vet Sci 9(12): 1731815.

79. J Cao, X Wang, Y Lei, X Jiang, K Kannan, et al. (2025) Health Risks of Low-Dose Dietary Exposure to Triphenyl Phosphate and Diphenyl Phosphate in Mice: Insights from the Gut-Liver Axis. Environ Sci Technol 59(18): 8960–8971.

80. N Ozkan, H Sahin, AP Kısaarslan, H Saracoglu (2024) Comparison of dietary inflammatory index and total antioxidant capacities of familial Mediterranean fever and healthy adolescents. J Hum Nutr Diet 37(5): 1245–1254.

81. E Pain, Stuart Snowden, Joseph Oddy, Sonia Shinhmar, Yousef M A Alhammad, et al. (2024) Pharmacological inhibition of ENT1 enhances the impact of specific dietary fats on energy metabolism gene expression. Proc Natl Acad Sci USA 121(36): e2321874121.