蛋白水解产物对婴幼儿成长的作用

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摘 要: 婴幼儿由于胃肠道发育不成熟、功能不足, 导致其成为食物过敏反应患病率较高的群体, 往往会出现过敏性反应、消化功能紊乱、胃肠道不适等疾病。这与婴幼儿早期暴露牛奶、鸡蛋和其他主要致敏食物蛋白相关。目前对于预防婴幼儿过敏性疾病最好的食物为母乳和水解蛋白配方奶粉。本文对当前国内外关于蛋白水解产物在婴幼儿发育中的应用研究进行综述, 讨论蛋白水解产物的营养配方及影响其性质的主要因素, 以及水解蛋白配方奶粉在婴幼儿成长过程中的作用, 以期为婴幼儿的健康成长提供一定的理论指导。

关键词: 水解蛋白配方; 婴儿; 蛋白过敏

Effect of proteolysis products on infant growth

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ABSTRACT: Due to immature gastrointestinal development and inadequate function, infants and young children have become a group with a higher prevalence of food allergic reactions, and often suffer from allergic reactions, digestive disorders, and gastrointestinal disorders, which is linked to early exposure to milk, eggs and other major allergenic proteins in infants and young children. At present, the best foods for preventing allergic diseases in infants and young children are breast milk and hydrolyzed protein formula. This article reviewed the current domestic and foreign research on the application of protein hydrolysates in the development of infants and young children, discussed the nutritional formula of protein hydrolysates and the main factors affecting their properties, and the role of hydrolyzed protein formula in the growth of infants and young children, in order to provide some theoretical guidance for the healthy growth of infants and young children.

KEY WORDS: hydrolyzed protein formula; infants; protein allergy

1 引 言

婴幼儿是食物过敏反应患病率较高的群体, 由于其内源性基因调控和免疫系统未发育完全, 往往会出现过敏性反应、消化功能紊乱、胃肠道不适等疾病, 这与婴幼儿早期暴露牛奶、鸡蛋和其他主要致敏食物蛋白相关[1,2]。1 岁以内婴幼儿血清免疫球蛋白 E(serum immunoglobulin E, IgE)介导的食物过敏发病率约为 6%~8%[3], 远高于成人食物过敏发病率(1%~2%), 过敏反应严重影响着婴幼儿的健康发育。目前对于预防婴幼儿过敏性疾病最好的食物为母乳和水解蛋白配方奶粉[4,5], 但很多情况下难以实现母乳喂养, 因此水解蛋白在婴幼儿配方食品中极其重要。水解蛋白是通过对蛋白质进行水解, 形成的短肽及游离氨基酸, 从而使蛋白质更加容易吸收, 并改善胃肠道耐受性, 降低婴儿对奶粉的过敏反应[6]。

本研究对当前国内外关于蛋白水解产物在婴幼儿发

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育中的应用研究进行综述, 讨论蛋白水解产物的营养配方及影响其性质的主要因素, 以及水解蛋白配方奶粉在婴幼儿成长过程中的作用, 以期为婴幼儿的健康成长提供一定的理论指导。

2 蛋白水解产物的营养配方及影响其性质的主要因素

蛋白质水解产物是指在加热或酸、碱、酶等物质的催化作用下, 将大分子蛋白质分解为小分子蛋白质、肽类或氨基酸等混合物, 以减少大分子蛋白质的致敏作用[7]。根据蛋白质水解程度的不同, 可将其分为部分水解蛋白(partial hydrolyzed formula, pHF)、深度水解蛋白(extensive hydolyzed formula, eHF)和完全水解蛋白(amino acid formula, AAF)[8]。蛋白质的水解产物在人体内要比自由氨基酸和没有水解的蛋白质更易于吸收[9]。

2.1 部分水解蛋白配方

部分水解蛋白, 也称为适度水解蛋白, 其原理是将牛奶蛋白进行适度的加热或酶解, 使之成为较小片段的蛋白或者小肽段, 其蛋白分子质量普遍分布在 3000~10000 Da 之间[10,11]。蛋白质被适度水解后可以改变其本身的抗原决定基, 减少变应原性, 从而降低了牛奶蛋白过敏的风险[12]。大多数欧洲营养专业委员会均建议易患过敏疾病的非母乳喂养或部分母乳喂养婴幼儿使用 pHF 奶粉[13]。Von 等[14]在研究中指出, 当婴幼儿患牛奶蛋白过敏症(cow's milk protein allergy, CMPA)且无法进行母乳喂养时, 应尽早服用 pHF 奶粉至 4~6 个月龄, 可有效降低 CMPA 和湿疹的累积发病率。另外的, pHF 乳粉不仅可以作为患 CMPA 婴幼儿在治疗过程中从 eHF 转为普通配方时的过渡饮食干预选择, 还可以用于预防健康婴幼儿牛奶过敏[15]。

2.2 深度水解蛋白配方

深度水解蛋白配方相比部分水解蛋白配方水解程度更大, 其中容易引起过敏反应的 95%以上乳蛋白被水解成分子质量小于 3000 Da 的二肽、三肽和少量游离氨基酸的终产物, 使牛奶蛋白的抗原性明显降低[16,17]。eHF 根据蛋白质来源的不同, 分为深度水解酪蛋白配方、深度水解清蛋白配方以及深度水解酪-清蛋白配方[18]。牛奶蛋白水解配方奶粉是一种基于此物质的特殊医用配方奶粉, 由于免疫系统对这些短肽不会产生有效的免疫反应, 适合于治疗婴幼儿胃肠道功能不全、消化道蛋白酶水平低等引起的过敏反应[19]。有研究报道, 高过敏风险的婴幼儿可能比过敏症状较轻的婴幼儿更适合使用 eHF 奶粉[20]。但是, 由于 eHF 有大约 5%的蛋白质没有水解, 残留的微量过敏原仍可引起 5%~10%的 CMPA 婴幼儿的胃肠道反应和其他的非 IgE 介导的过敏反应[21]。

2.3 完全水解蛋白配方

完全水解蛋白配方又称为游离氨基酸配方。该配方的奶粉完全不含过敏原、不含肽段, 完全由游离氨基酸按一定的比例组成, 并且可以根据婴幼儿代谢状况, 某些矿物质和维生素的含量可以适当调整[22,23]。AAF 配方奶粉可以确保高的生物利用率, 并且含有丰富的链脂肪酸和硫氨基酸, 对促进婴幼儿体内营养物质的运输和消化吸收有很大帮助, 而且没有明显的胃肠粘膜刺激反应[24]。据有关报道, AAF 对婴幼儿乳蛋白过敏的治疗有效率高达 99%[25]。一般针对严重 CMPA 导致生长发育障碍的婴幼儿才会选用 AAF 乳粉, 但不适合长期食用, 随着年龄的增长, 婴儿的免疫能力、消化能力也有所提高, 便可以逐渐进行改变[26]。

2.4 影响水解蛋白性质的主要因素

对水解蛋白带来功能性改善性质影响最大的因素为蛋白质的水解程度, 目前国内外常用的蛋白水解度测定的方法有: 滴定水解中释放的质子法、三硝基苯磺酸法、甲醛滴定法、茚三酮法、邻苯二甲醛法及荧光胺法等[27]。而对于水解蛋白配方影响其预防过敏的因素除了水解程度外, 还包括蛋白质来源(如乳酪蛋白、乳清蛋白配方和乳酪-清蛋白)、水解方法(酸、碱、酶水解法和发酵法)以及水解温度等[28,29]。张邵博等[30]在研究中表明, 水解条件的确定应综合压力、温度、pH、酶与底物浓度的比值等条件筛选最优条件得到理想的水解产物。而根据不同的蛋白质水解产物, 选择的工艺流程也略不同, 其主要的生产工艺为先对不同来源的蛋白质采用不同的水解方法进行水解, 进一步的通过升温或者改变 pH 值终止水解, 对水解后的产物进行过滤、离心、超滤、层析[30], 不同工艺过程形成的短肽、氨基酸数量及种类均会不同, 从而对婴幼儿胃肠道产生不同的影响[31]。

3 水解蛋白配方奶粉对婴幼儿成长的作用影响

3.1 对特殊婴幼儿提供充足的营养供给

水解蛋白奶粉本身是良好的营养补充剂, 不仅能满足健康婴幼儿的营养需求, 也能很好的满足早产儿、术后患儿等特殊婴幼儿对营养的需求[32]。Szajewska 等[33]研究证实水解蛋白配方奶粉可以与普通奶粉一样对婴幼儿提供足够的营养。Rzehak 等[34]对德国 1840 名婴儿长达 6 年的营养干预研究, 发现喂养部分水解乳清、深度水解乳清、深度水解酪蛋白配方奶粉与喂养牛奶配方奶粉以及母乳喂养的婴儿, 不同配方对体重指数没有长期影响。而黄晓虹[35]则探讨和研究了水解蛋白配方奶粉对新生儿外科肠道手术后康复及体重增长的影响, 通过将水解蛋白配方奶粉与常规配方奶粉进行喂养对比, 发现水解蛋白配方奶粉不仅能够有效改善术后新生儿的肠道功能, 促进肠道吸收, 同时还能提高营养供应效率。

3.2　降低婴儿过敏反应

婴儿对乳蛋白过敏的临床表现涉及多器官多系统, 主要以皮肤和胃肠道过敏反应为主[36,37]。对于皮肤过敏反应, 常见症状有湿疹、特应性皮炎、过敏性皮炎等[38]。Von Berg 等[39]通过双盲干预试验证实水解蛋白配方乳粉能够预防过敏作用, 并能在 6 岁之前基本上弥补湿疹的风险。王敏等[40]研究表明水解蛋白配方乳粉能够显著提高婴幼儿特应性皮炎治疗有效率, 可从 29.78%提高至 68.62%。而对于胃肠道过敏反应, 常见的症状为腹泻、呕吐、胀气等反应[41]。主要原因为婴幼儿肠黏膜细胞稀疏, 肠胃胰蛋白酶缺乏, 肠道渗透压较高使得肠道免疫应答处于敏感状态, 当摄入大分子蛋白质时, 则会引起胃肠道过敏反应[42]。颜海青等[43]证明 eHF 奶粉治疗婴儿牛奶蛋白过敏性腹泻疗效显著。储寅玥等[44]对极低出生体重儿实施早期微量 eHF 喂养, 结果证明患儿腹胀、呕吐的发生率明显降低。

3.3　改善婴幼儿胃肠道耐受性

水解蛋白配方乳粉不仅易于被婴幼儿胃肠道消化吸收, 还可通过提高婴幼儿胃肠道耐受性来缓解便秘、腹泻、呕吐等胃肠道过敏反应[45,46]。研究表明, 水解蛋白提高婴幼儿胃肠道耐受性的机理主要为促进胃排空以及增加胃肠蠕动[47]。崔群[48]研究表明, eHF 可促进早产儿胃排空作用。Yu 等[49]通过实验证实 eHF 可明显改善早产儿胃肠动力, 加速胆红素代谢和排泄, 从而提高胃肠道耐受性。另外, 水解蛋白还可以通过抑制牛奶蛋白源性阿片受体激动剂的活性来改善婴幼儿胃肠道耐受性。Mihatsch 等[50]的研究结果表明, 酪蛋白水解通过降低消化过程中释放的阿片类物质活性来加速胃肠道的运输, 从而达到改善胃肠道耐受性的目的。

4　结　论

婴幼儿由于胃肠道发育不成熟、胃肠道功能不足, 导致其为食物过敏反应患病率较高的群体, 往往会出现过敏性反应、消化功能紊乱、胃肠道不适等疾病。研究证明, 水解蛋白配方奶粉与普通奶粉相比蛋白质分子质量较小, 更容易被婴幼儿消化吸收。在满足基本营养的同时, 喂养水解蛋白配方奶粉可以改善患牛奶蛋白过敏症婴幼儿的胃肠道耐受性, 以减少其对奶粉的过敏反应。因此, 进一步研究多种低致敏、高耐受、易吸收的水解蛋白配方食品, 对我国婴幼儿的健康成长具有重要意义。

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