Entonces

$$a_0 = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)dx \underset{\substack{\uparrow \\ f \text{ función par}}}{=} \frac{2}{\pi}\int_0^{\pi} f(x)\,dx \;,$$

$$\int_0^{\pi} f(x)\,dx = \int_0^{\pi} -\operatorname{Ln}\left|2\operatorname{sen}\frac{x}{2}\right| dx = \int_0^{\pi} -\operatorname{Ln}\left(2\operatorname{sen}\frac{x}{2}\right) dx =$$

$$-\int_0^{\pi} \operatorname{Ln} 2\,dx - \int_0^{\pi} \operatorname{Ln}\left(\operatorname{sen}\frac{x}{2}\right)dx \;,$$

$$\int_0^{\pi} \operatorname{Ln}\left(\operatorname{sen}\frac{x}{2}\right) dx \underset{\uparrow}{=} 2\int_0^{\pi/2} \operatorname{Ln}(\operatorname{sen} u)\,du \underset{\uparrow}{=} -\pi \operatorname{Ln} 2$$

$\frac{x}{2} = u$

$\frac{dx}{2} = du$

$x = \pi \Rightarrow u = \pi/2$

$x = 0 \Rightarrow u = 0$

Nos lo creemos de momento y luego lo probamos $*_1$

$$\Longrightarrow \int_0^{\pi} f(x)\,dx = -\pi \operatorname{Ln} 2 - (-\pi \operatorname{Ln} 2) = 0 \quad \Longrightarrow a_0 = 0$$

Como la función es par todos los términos b_n que multiplican a los $\operatorname{sen}(nx)$ serán 0 ya que

$$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\operatorname{sen}(nx)\,dx \quad \text{y} \quad g(x) = f(x)\operatorname{sen}(nx) \text{ es impar}$$